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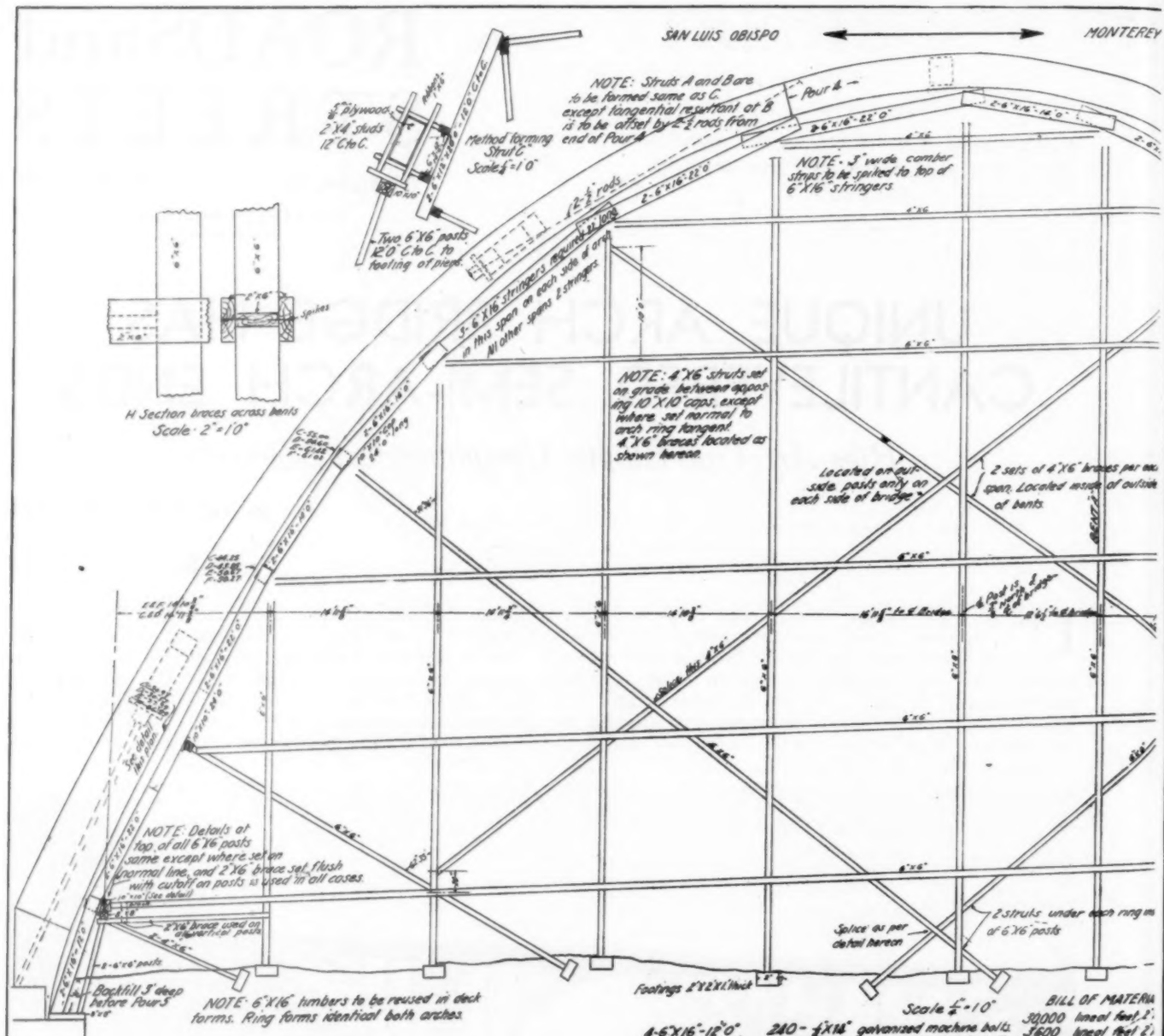
UNIQUE ARCH BRIDGE HAS CANTILEVERED SEMI-ARCH ENDS

Ribs Are True Elliptic Unsymmetrical Segments

By VICTOR J. BROWN
Publishing Director
ROADS AND STREETS

UNSTABLE canyon slopes, solid rock foundation conditions available near the junction of the canyon slopes and the stream floor, a mixture of gravelly-clay and boulders in stream floor between canyon slopes, a high crossing, desirable simple yet artistic design, and a type of structure least affected by the fogs and rains of the Pacific Ocean, all tended to dictate the multiple arch span as a desirable crossing structure for the Big Creek bridge on the Carmel-San Simeon highway about 50 miles south of Carmel, California. The bridge is unusual in that the end spans are half arches cantilevered from the end columns. This was necessary because of the unstable condition of the canyon walls. The cantilevered half-arch ribs are pin

Big Creek Bridge on Carmel-San Simeon Highway. California. Shows Unique Design.



Arch Falsework for Big Creek Bridge

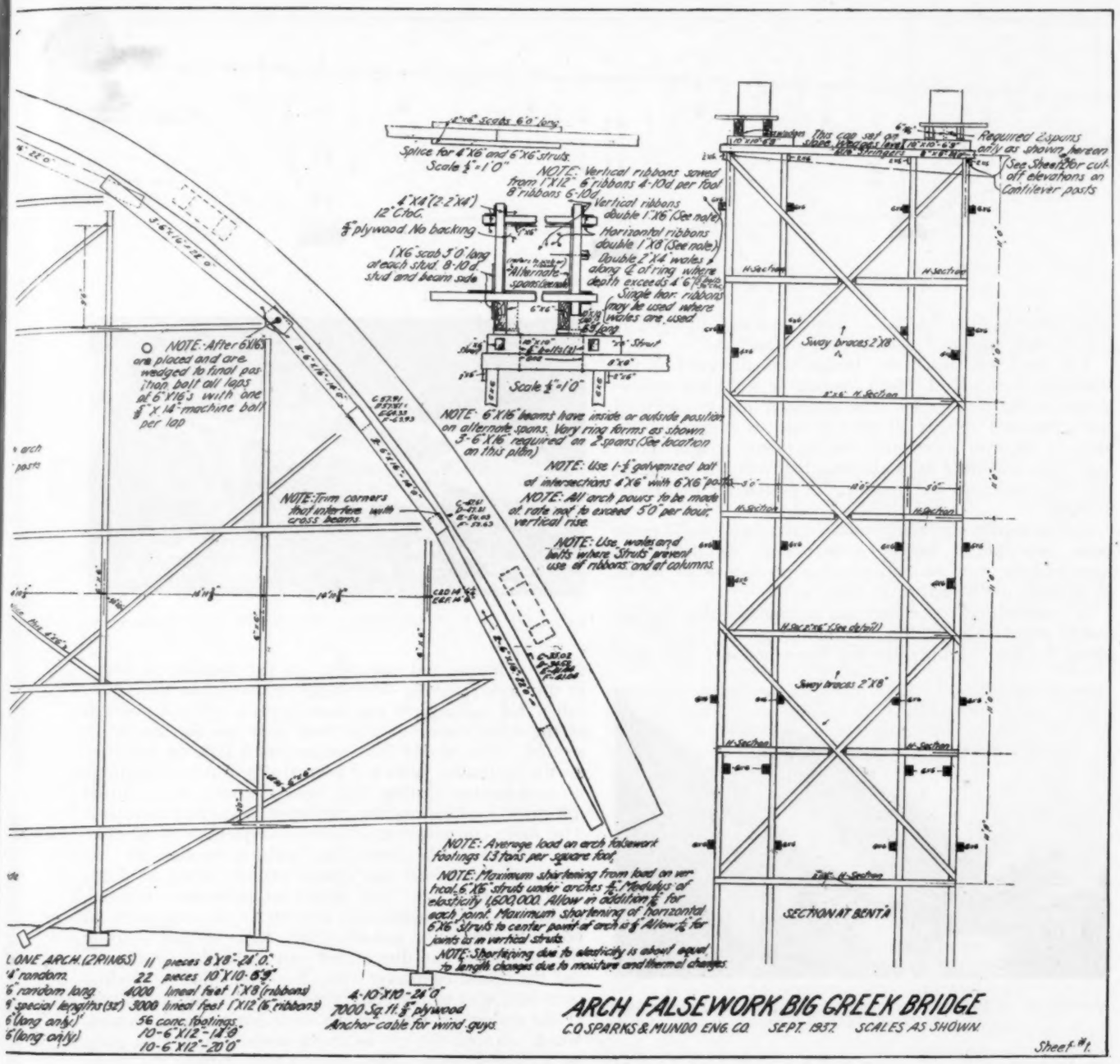
connected at their bases to the end columns and are held in place by eye-bars which extend from end to end of the bridge.

At the point where Big Creek empties into the ocean the highway grade is about 90 ft. above the bed of the creek. To span the canyon a bridge over 500 ft. long was required.

At the ends of the bridge where the floor joins up with the highway slab is a large amount of loose rock unsuitable as foundation material for the ordinary abutment for a beam type span bridge. To construct a supporting pier for the ends of a beam type span would have been uneconomical and unsafe, as preliminary investigation indicated that the material would undoubtedly slide.

Two Full Arches

The structure consists of two central span open spandrel arches, each 177 ft. 6 in. center to center of supports. At each end is an 81 ft. 6 in. cantilevered half-arch, and a 34 ft. 6 in. girder span. The bridge will provide a 24 ft. roadway between curbs when complete. The accompanying line drawing shows a cross section of the bridge along the longitudinal center line. The ribs are true elliptic arches unsymmetrical due to the difference in elevation of the footings and to the grade of the structure. Another unique feature of the structure is the eye-bar support of the cantilevered half-arch end spans. These extend the full length of the bridge and are located in the outside girders. In the end spans, the eye-bars are coated or wrapped with an asphaltic blanket and then encased by the concrete of the girders. Over the full arches the eye-bars are embedded in the concrete without wrapping and are fixed at the main column heads. In the ends of the half-arch ribs are embedded



Arch Falsework for Big Creek Bridge

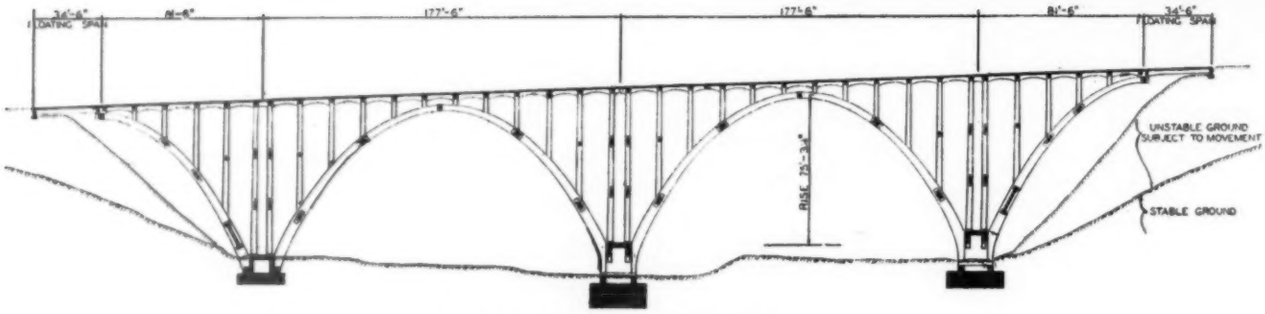
structural steel brackets about 15 ft. long to which the eye-bars are pinned. The brackets were designed long enough to insure dissipation of stress to the arch ribs.

Footings

The end footings rest directly upon rock but the center footing is placed upon a mixture of gravel, clay, sand, and boulders. The bridge footings were designed to rest upon a foundation that would withstand a load of 5 tons per sq. ft. During construction of the center footing it was discovered that instead of an anticipated boulder stratum silty sand and gravel were encountered. A test hole showed sand and gravel to extend to a considerable depth. The footing was then excavated larger and back-filled level. The increased size of footing lowered the foundation load from 5 tons to 3 tons per square foot. During construction of this center footing slight settlement occurred and continued gradually until the center main column was two-thirds poured. Thereafter, no further settlement was observed. The total settlement was 0.06 ft. Engineers on the job kept rather close watch on all settlements and deflections during construction.

Design Data

In design, steel stresses adopted by the American Association of State Highway Officials were used. Concrete was designed for 1,000 lb. per square inch and up to 1,250 lb. per square inch for temperature and rib shortening stresses. However, 5,000 lb. concrete in 28 days was obtained. Normal temperature was taken on this job at 60 deg. F. A novel feature besides the eye-bars in the design is the copper seal encasing the eye-bars at the expansion joints. The copper seal completely surrounds the eye-bars, is embedded in the concrete, and extends a short distance longitudinally into the concrete to prevent water entering at the open expansion joints



Longitudinal Section of Big Creek Bridge.

from reaching the eye-bars. The handrail employed is California's standard open type post and rail.

The load for which the bridge was designed is the standard A.A.S.H.O. H-15 loading or a 50-ton power-shovel on crawler tracks. The standard impact was used and amounted to near 30 per cent on the end spans. In view of the ever increasing size of motor freight transport units traveling the California highways, it is evident that this structure will have to be posted for maximum loading.

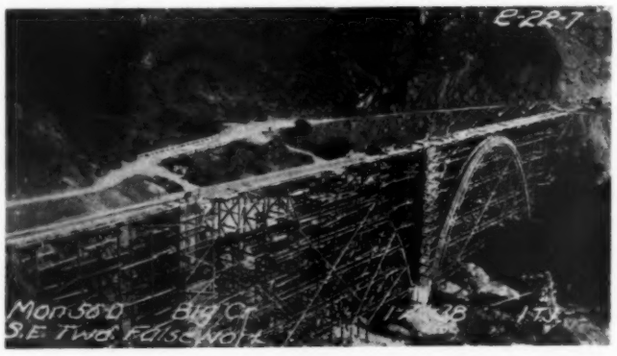
It was known that temperature variations would cause large movements during construction, so deflections were closely watched and pouring procedure so varied as to keep the structure in balance.

A construction procedure was designed so that loading would progress in such a manner as not to cause overstress in any member during construction. The steel

North Half of Bridge Site Showing Highway on Canyon Side. Pacific Ocean in Background.

eye-bars were to be prestressed for full dead load by means of toggle joints. One hundred twenty-five ton hydraulic jacks were employed to actuate the toggle joints which were located on each side over the center column or pier. When there is no live load on the bridge, such as highway traffic, the end spans are tied through the bridge to each other and balance themselves. When there is an unbalanced live load, such as a heavy truck on one end of the bridge, this unbalanced load is supported by transmitting the stresses through the eye-bars to the main piers which are designed to handle such unbalanced live load. After prestressing the eye-bars with the toggle joint, short connecting eye-bars were made to fit over the pin ends and the arms of the toggle dismantled and embedded in the concrete.

During construction modifications were made in the designer's constructure procedure. One change was in eliminating construction joints in the deck over the columns and placing them about 5 ft. out from the columns in alternate spans. This eliminated a difficult form detail

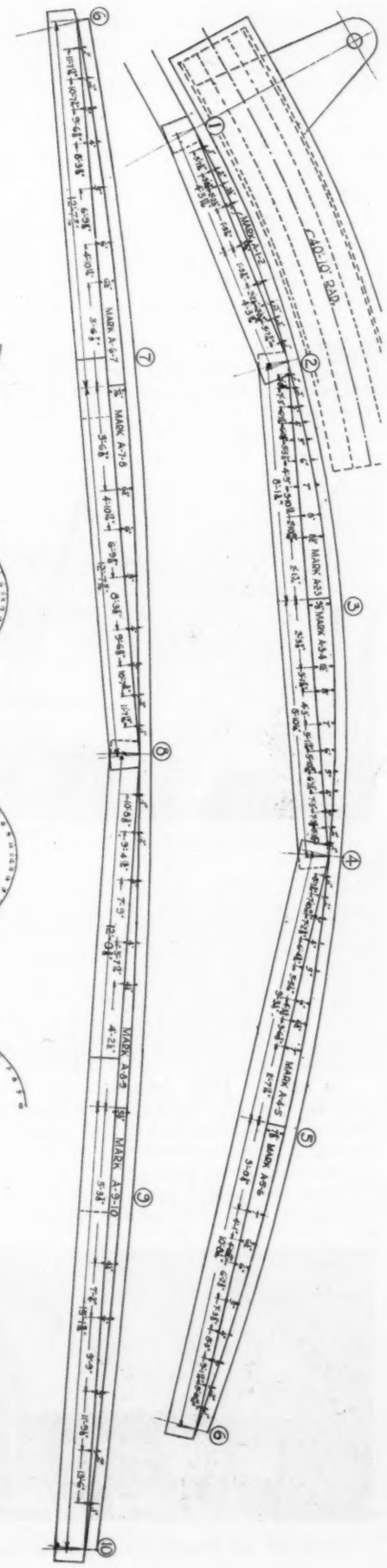


Falsework for Big Creek Bridge. Note Old Road in Background.

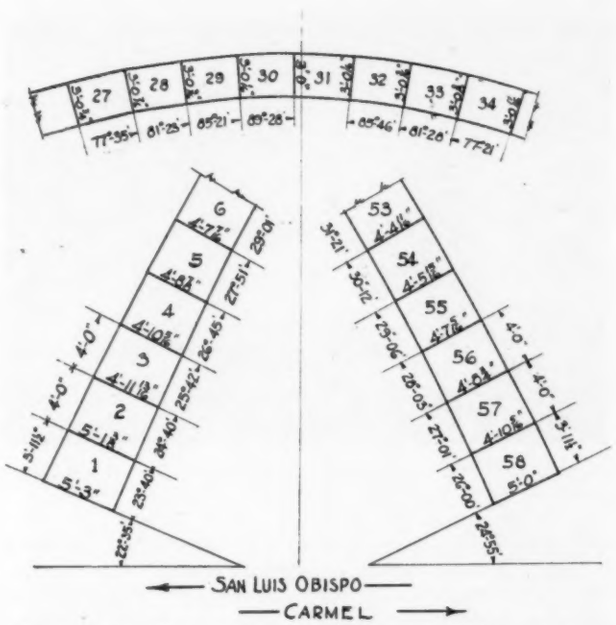
at the columns and cut down on the number of pours in the deck systems. The design construction procedure called for jacking the end cantilevers to correct position at the completion of each deck pour on the cantilever section. This would have necessitated holding pressure on the hydraulic jacks for several days. Also variations in temperature during this period would have caused difficulty in adjusting the cantilever to correct elevation. The safer construction procedure seemed to be to raise the cantilever rib above plan position enough so that when full dead load was placed the rib would be down to correct position. This caused an unforeseen problem which created considerable interest to the engineers of both the contractor and the state. Prior to this decision the contractor had dismantled part of his falsework, under the south cantilever ribs, from the pied to slightly over half way to the end. Although blocking was placed at the end it did not prevent some horizontal movement which allowed the rib to move ahead and act partially as a curved beam. This beam action caused the lower end of the ribs to deflect about ⅜-in. and hair cracks to form.

In an endeavor to bring back the south cantilever ribs to true shape and to try out the hydraulic jacks, a pre-

North Cantilevered Arch Rib and Falsework.



Contractors' Drawings for Cutting Radius Strip Forms for Cantilevers A and B. Contractor's Engineer Designed All Frame Work and Calculated Stresses and Deflections Prior to Work.

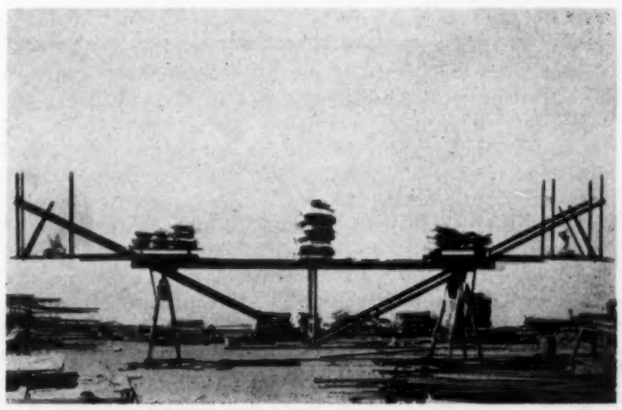


Showing Size, Shape and Spacing for Cutting Plyboard Forms on Lower Haunches and Crown of Arch Ribs.

liminary jacking was made. It was soon discovered that, due to the slenderness of the rib and the extreme stiffness of the cantilever rib at the end where the structural steel assembly necessary for the pin and eye-bar connection is located, that instead of raising the ribs in a uniform variation from the lower hinge the ribs began to deflect upwards opening the construction joint in the key just beyond the structural steel assembly. Slight hair cracks also developed and the ribs were lowered to the falsework.

Model Studies

This immediately caused the construction engineers to lay out block and spline models of the rib on a scale of 1 in. to the foot. By shifting equivalent loadings about on the model and measuring deflections, a construction procedure was developed which kept the rib true to shape at all times. The model studies showed that by pouring the end girder spans, the line of thrust would be lowered sufficiently to allow jacking and raising the cantilever ribs as planned. By placing extra dead load on the girder span near the pier connection reverse stress would be set up which would tend to correct the shape of the south ribs. A ten (10) ton load of sacked cement was therefore placed on the south girder span. Actual results



Contractor's Model to Test Girder and Deck Falsework Expected to Be Used But Later Eliminated.

Falsework Wreck of Span 2-3 After 70-Mile Gale When About 80 Per cent Complete.

followed model indications with remarkable closeness. There was some lag in the south cantilever ribs in shaping themselves back to true position. However a short time of completing the deck pours over the cantilever ribs, the ribs were found to be back to their original shape, and all hair cracks were closed.

By way of comment, it should be stated that later study by the designer indicated that, at this stage of construction (ribs and spandrel columns only) the line of thrust lay about 4 ft. above the center arch rib which is only 3 ft. deep at the key. The consulting engineer for the contractor also built a model. His studies checked deflection measurements of the state construction engineer's model studies quite closely. These studies resulted in a construction procedure different slightly from that prepared by the designer. The design department expected the whole structure to rest upon falsework during construction whereas, the procedure was changed, as stated before, to hanging the cantilevered half-arches.

Unloading Reinforcing Steel. Note Size of Transport Units.

Construction

Instead of using a high line for erecting the falsework and transporting materials, the contractor utilized the falsework to support a runway for the workmen and tracks for the concrete buggies. Concrete was deposited into place in the ribs, struts, and columns from buggies through an elephant trunk.

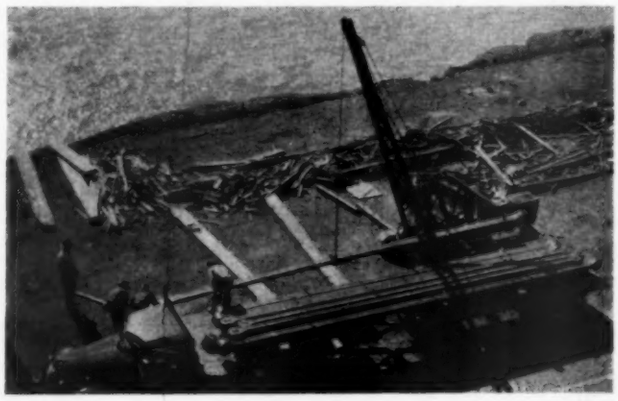
It is interesting to note that the curvature for each plank in the form work supporting the arch was calculated and cut to accurate measure in a shop in Los Angeles before it was shipped to the job site. Likewise, the plywood panels used for form facing were cut to accurately calculated measurements. However, this cutting was done with a Skilsaw on the job. The contractor's shop drawing of the form cutting for the arch curvature of a cantilevered end is shown herewith.

Also shown herewith a sample of the sawing diagram for the plywood form facing boards. The whole bridge now has a neat appearance resembling closely pointed stone work, caused by the regular, even, careful, form work. The forms were all hoisted by individual pieces and then built-in-place.

As in all construction work, the contractor's investment was subject to the actions of the elements. On this job a 70-mile gale blew down the falsework of span 2-3 after it was about 80 per cent complete. An accompanying diagram shows the contractor's falsework design for the arch centering and supports.

After the girder and deck construction procedure was determined the first step was to pour the end connecting beam spans. These were done on July 9, 1938. This, then, permitted the cantilevered ends to be hung free of the falsework.

By July 15, 1938, the side eye-bars were in place and the next day the girders of the 4 end panels of each cantilever was poured. Procedure employed was to pour 1½ panels each way from piers 1 and 3 toward the pin on the end. Then pouring started at the pin and continued toward the piers. This procedure checked the model test results; the first pouring raised the cantilevered ends up 1/16 in.; the second pouring near the pin lowered the end ¼ in. It was stated, previously, that one of the reasons for changing design was the practical difficulties of construction over the column heads. Consequently, a mid-span construction joint was designed such that 1½ panels would be poured at one operation.



Unloading Eye Bars.

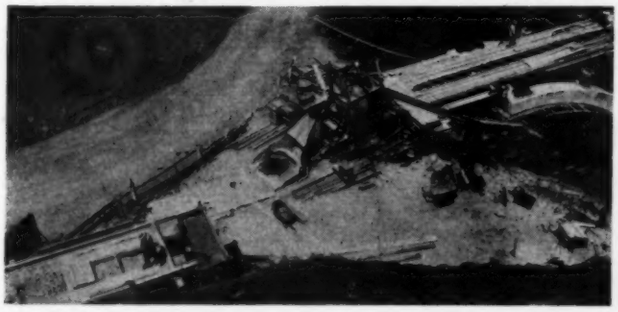
On July 19, 1938, the slab on the four panels on each end was poured. Next the pier heads and girders were poured in balancing procedure, followed by the slab and the whole was completed on July 29, 1938. The handrail is just now going into place. In pouring the slab, the concrete for which was all moved out in buggies, the contractor devised a rolling bridge which spanned the

Cantilever Rib Bracket for Anchoring Ends of Eye Bars.

Contractor's Batching Plant.

whole deck. Pours were made to keep a balance at all times.

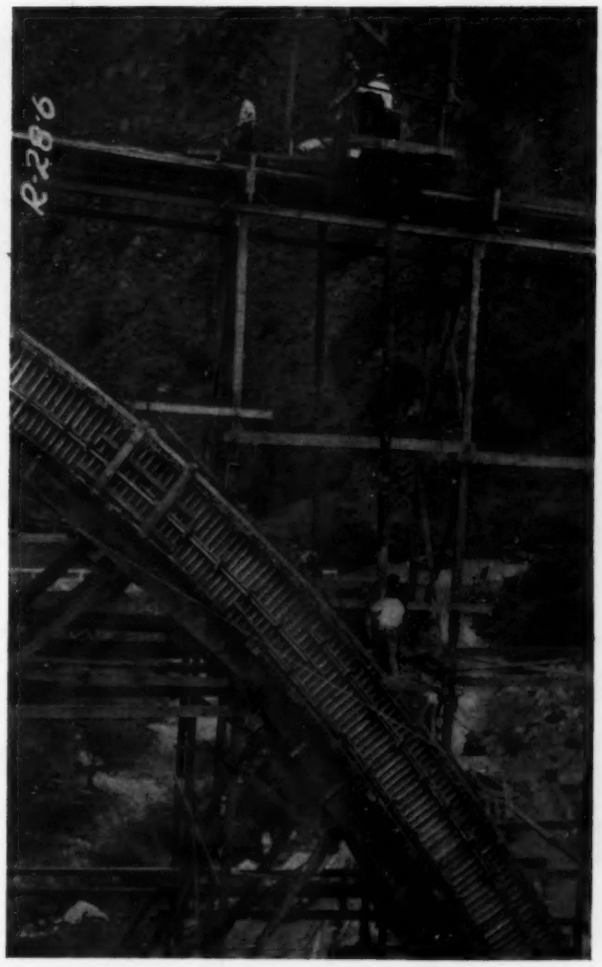
Before the pouring of slab and girders started, the contractor set up a model truss which he thought of employing to hold the load. The model, a picture of which accompanies this article, was loaded with bags of cement and deflections measured. However, the resident state construction engineer, Mr. Johnson, suggested that the truss design of formwork could be eliminated and the regular falsework would be strong enough. Load and deflection calculations were made which indicated the advisability of the engineer's suggestion. That simple statement, made during a conversation regarding procedure, saved the contractor about $4,000, according to his own statement.



Looking Down on Batching Plant and Mixer. Aggregates Are Weighed in Wheelbarrows or Platform Scales Under Storage Bins and Wheeled to Mixer Skip.

Construction Plant

Aggregates were obtained from three different sources. A crushing and screening plant was set up in the canyon bed and aggregates trucked from there up on top to a 4-bin storage bunker, containing 2½ in., 1½ in. and ¾ in. rock and one for sand. Beneath each bunker or bin was a platform scales on which the wheelbarrows with aggregates were weighed before they were wheeled over to the skip of the 21E Foote paver used for mixing. From the mixer the concrete was dumped into a hopper from which the concrete buggies were loaded. Concrete dead loads were greater than designed due to the fact that aggregate rock had a specific gravity of 3.00 as compared with the designed 2.65. The mix was well designed and gave a high slump at low w/c ratios. A somewhat higher slump was used in the slender, heavily reinforced members. Usual slump, however, was 2 in. with an 0.74w/c ratio. All concrete was vibrated.

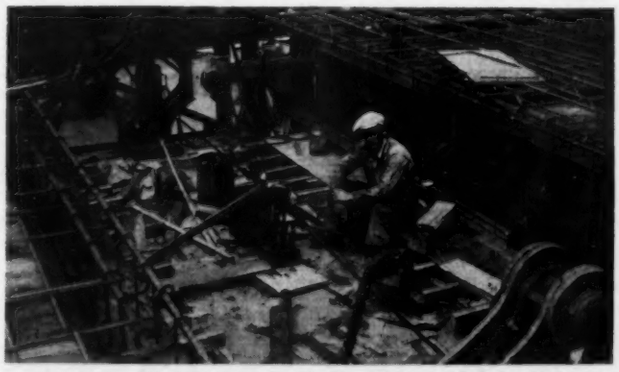


Pouring Arch Rib. Concrete Rolled in Buggies from Mixer and Dropped to Place Through an Elephant Snout.

Important lessons taught by the construction of this bridge are (1) the value of close cooperation between the engineer and the contractor, and (2) the value of constant observation, calculation, and checking of deflections during construction.

Personnel

Studies of the site and design were made by various members of the bridge department. The bridge was designed by Mr. H. E. Kuphal, Mr. L. C. Hollister, Chief Designing Engineer. Mr. F. W. Panhorst is the



Jacking the Toggle Joints. Hand Operated Hydraulic Jack Exerted 125 Ton Load on Eye Bars for Prestressing Them.

North Cantilevered Rib Bracket Concreted in Place

bridge engineer of the California Division of Highways. C. H. Purcell, State Highway Engineer.

C. O. Sparks and Mundo Engineering Company of Los Angeles are the contractors who have just finished construction.

Mr. W. T. Ellington is superintendent of construction for the contractor and Mr. I. O. Jahlstrom, construction engineer for the state; Mr. I. T. Johnson was resident engineer.

The bridge is a simple artistic structure evidencing careful construction and skilled workmanship.

▼

WHERE THE HIGHWAY USERS' TAX DOLLAR GOES

Thirteen and one-half cents out of every dollar of State taxes paid by highway users in 1937 was assigned to uses other than highways, according to statistics from state authorities collected by the Bureau of Public Roads of the U. S. Department of Agriculture. This is 2½c less than the non-highway use in 1936. Highway user revenues distributed by the states amounted to $1,195,-132,000.

These revenues included registration and license fees amounting to $410,401,000, gasoline taxes of $768,010,-000, and special taxes on motor carriers of $16,721,000.

The revenues were distributed: $705,312,000 for state highway departments—a sum nearly equal to actual expenditures on primary state highways and urban extensions—$277,617,000 for local roads and streets, $8,261,-000 for State park and forest roads, $42,529,000 for collection and administration, and $161,413,000 for education, relief and other non-highway purposes.

The accompanying table shows the distribution of highway-user revenues.

DISPOSITION OF RECEIPTS FROM STATE IMPOSTS ON HIGHWAY USERS—1937

(All amounts in 1,000 dollars)

State	Net total receipts of calendar year 1/	Adjustments due to undistributed funds, etc. 2/	Tax on aviation gasoline deducted	Net total funds distributed	Expenses of collection and administration 3/	For state highway purposes: Construction, maintenance, and administration 4/	State highway police	Service of state highway obligations: State highway bonds and notes	State-assumed local obligations 5/	Total	Total for state highway purposes
Alabama	10,009	197	-	10,202	680	6,499	406	3,207	-	3,207	10,072
Arizona	5,638	-2	-	5,636	316	3,847	141	-	-	-	3,988
Arkansas	13,205	-	-	13,205	452	3,023	130	5,958	2,833	8,791	11,944
California	75,675	-177	-	75,498	3,895	30,163	2,644	3,964	-	3,964	36,768
Colorado	10,695	-4	-	10,691	731	5,686	258	720	-	720	6,662
Connecticut	16,398	-631	-	15,767	1,175	6,595	325	-	2,083	2,083	11,593
Delaware	3,236	75	-	3,311	115	4/ 2,196	210	65	320	385	2,793
Florida	20,584	12	-	20,596	1,139	9,123	39	-	3,300	3,300	12,462
Georgia	22,073	206	-	22,279	975	11,329	380	-	2,673	2,673	14,382
Idaho	6,646	55	6	6,690	116	4,426	136	-	-	-	4,562
Illinois	57,696	464	-	58,160	1,806	20,703	1,856	8,837	382	9,219	31,398
Indiana	34,086	2,938	-	36,884	1,298	18,662	446	-	-	-	19,108
Iowa	25,502	122	-	25,624	1,626	9,701	-	-	8,087	8,087	17,788
Kansas	15,936	-296	-	15,640	1,433	9,167	136	384	1,000	1,384	10,687
Kentucky	18,190	127	-	18,317	600	15,090	185	-	-	-	15,275
Louisiana	20,713	-204	-	20,509	257	4,046	442	7,960	-	7,960	12,448
Maine	9,437	-5	-	9,432	188	5,623	275	2,412	-	2,412	8,310
Maryland	15,459	-995	-	14,464	612	5,625	378	10/ 2,963	-	2,963	8,966
Massachusetts	26,766	213	-	26,979	1,720	7,081	350	11/ 3,243	-	3,243	10,674
Michigan	51,918	-140	39	51,739	2,150	20,302	341	3,000	-	3,000	23,643
Minnesota	26,383	35	-	26,418	600	14,205	281	1,790	2,304	4,094	18,595
Mississippi	12,628	-4	-	12,624	303	3,050	38	2,562	-	2,562	5,650
Missouri	21,376	401	-	21,777	400	13,095	388	7,480	-	7,480	20,963
Montana	6,159	152	-	6,311	127	4,066	155	566	-	566	4,787
Nebraska	13,660	-159	25	13,476	384	6,584	75	-	-	-	7,059
Nevada	1,657	-	-	1,657	56	1,482	38	87	9	96	1,616
New Hampshire	5,637	57	-	5,694	133	3,782	179	829	-	829	4,790
New Jersey	46,955	163	-	46,118	1,985	5,533	-	7,633	-	7,633	13,166
New Mexico	5,719	142	-	5,861	333	3,005	120	1,605	-	1,605	4,730
New York 13/	114,816	-4,696	-	110,120	3,069	24,087	1,335	10,160	-	10,160	35,582
North Carolina	32,455	-440	-	31,018	580	4/ 19,408	612	9,425	475	9,900	29,920
North Dakota	4,535	-148	-	4,397	240	2,263	181	251	-	251	2,695
Ohio	72,665	1,983	-	74,648	1,667	26,173	503	-	-	-	26,676
Oklahoma	20,667	-335	-	20,332	1,580	10,351	295	-	-	-	10,646
Oregon	14,273	6	6	14,273	700	7,280	350	3,786	-	3,786	11,416
Pennsylvania	94,060	13/ 18,900	-	112,960	2,200	75,779	6,625	6,260	-	6,260	88,664
Rhode Island 13/	5,093	33	-	5,126	285	2,848	146	276	-	276	3,270
South Carolina	13,016	-45	31	12,940	394	5,354	282	1,736	3,330	5,066	10,708
South Dakota	6,289	326	3	6,612	217	3,406	3	-	-	-	3,409
Tennessee	25,980	-666	33	25,281	400	6,485	142	6,815	1,801	8,616	14,698
Texas	61,671	-27	-	61,644	2,057	26,709	165	-	10,296	10,296	37,170
Utah	4,546	-187	36	4,363	158	3,393	146	330	-	330	4,189
Vermont	4,733	358	-	5,091	90	2,530	95	605	-	605	3,230
Virginia	20,475	32	-	20,507	666	4/ 20,529	205	303	-	303	21,037
Washington	15,549	50	-	15,599	618	8,522	1,490	11/ 119	58	176	10,216
West Virginia	14,799	-	-	14,799	287	4/ 6,907	90	7,585	-	7,585	14,582
Wisconsin	34,296	-164	-	34,132	1,680	15,428	-	-	4,102	4,102	19,530
Wyoming	3,305	-5	33	3,286	90	2,210	64	370	-	370	2,640
Dist. of Col.	3,029	-2	-	3,027	140	-	-	-	-	-	-
Total	1,177,837	17,536	231	1,195,132	42,529	530,080	15,023	113,508	42,704	156,209	705,312

State	For local roads and streets 6/: For work on county and local roads 5/	For work on city streets 7/	Service of local highway obligations	Total	For other highway purposes (park and forest roads, etc.)	For non-highway purposes: To general funds 8/: Motor-fuel inspection fees, dealers' licenses, etc.	All other highway user imposts	For relief of unemployment or destitution	For education	For other specific purposes 9/	Total	State
Alabama	6,646	-	-	6,646	-	-	764	-	-	-	764	Alabama
Arizona	*1,297	-	-	1,297	-	-	-	-	-	7	7	Arizona
Arkansas	625	-	102	727	-	82	-	-	-	-	82	Arkansas
California	*19,093	3,595	-	22,688	-	-	10,157	-	-	-	10,157	California
Colorado	3,238	-	-	3,238	-	-	-	-	-	-	-	Colorado
Connecticut	3,049	-	-	3,049	-	-	-	-	-	-	-	Connecticut
Delaware	(4/)	21	-	21	218	-	-	-	-	8	8	Delaware
Florida	113	38	6,503	6,654	-	-	2,540	-	6,118	21	8,681	Florida
Georgia	3,763	-	-	3,763	-	-	-	-	3,239	-	3,239	Georgia
Idaho	*2,012	-	-	2,012	-	-	-	-	-	-	-	Idaho
Illinois	*9,303	*7,970	-	17,273	-	160	207	4,409	2,899	-	7,683	Illinois
Indiana	10,769	2,600	-	13,369	-	418	2,621	-	-	-	3,039	Indiana
Iowa	*6,210	-	-	6,210	-	-	-	-	-	-	-	Iowa
Kansas	3,600	-	-	3,600	-	-	-	-	-	-	-	Kansas
Kentucky	657	-	-	657	-	-	1,835	-	-	-	1,835	Kentucky
Louisiana	-	980	-	980	-	-	-	4,642	1,122	1,120	6,884	Louisiana
Maine	936	-	-	936	-	-	-	-	-	-	-	Maine
Maryland	930	3,600	735	5,265	-	-	-	-	-	-	-	Maryland
Massachusetts	4,150	-	11/ 488	4,638	11/ 1,179	-	6,600	11/ 1,968	-	-	8,568	Massachusetts
Michigan	*25,679	-	-	25,679	-	5	271	-	-	-	276	Michigan
Minnesota	*5,098	-	-	5,098	-	71	114	-	-	-	185	Minnesota
Mississippi	*6,338	-	-	6,338	182	-	-	-	-	-	-	Mississippi
Missouri	60	-	-	60	-	74	-	-	-	-	74	Missouri
Montana	1,339	46	-	1,385	-	-	-	-	-	-	-	Montana
Nebraska	*4,582	331	-	4,913	-	-	8	1,222	-	-	1,230	Nebraska
Nevada	-	-	-	-	-	-	-	-	-	-	-	Nevada
New Hampshire	461	-	12/ 285	746	25	-	-	-	-	-	-	New Hampshire
New Jersey	9,296	-	1,509	11,165	233	-	-	12,638	1,256	785	14,639	New Jersey
New Mexico	418	-	-	418	-	-	502	-	-	-	502	New Mexico
New York 13/	*19,837	6,629	-	26,466	5,690	-	39,973	-	-	-	39,973	New York 13/
North Carolina	(4/)	-	-	-	-	877	500	-	-	17	1,394	North Carolina
North Dakota	1,500	-	-	1,500	-	-	16	-	-	-	16	North Dakota
Ohio	*20,570	11,346	-	31,916	-	-	-	-	12,047	374	12,391	Ohio
Oklahoma	*6,269	-	-	6,269	-	4	-	-	-	1,852	1,856	Oklahoma
Oregon	*2,091	-	-	2,031	45	-	75	-	-	-	75	Oregon
Pennsylvania	*7,032	500	-	7,532	110	-	-	13,899	-	500	14,399	Pennsylvania
Rhode Island 13/	502	-	-	502	29	9	1,976	-	-	-	1,976	Rhode Island 13/
South Carolina	*1,912	10	-	1,922	-	186	-	-	-	-	186	South Carolina
South Dakota	1,392	-	-	1,392	46	38	-	-	-	1,662	1,700	South Dakota
Tennessee	5,090	-	-	5,090	-	581	66	-	-	1,849	2,496	Tennessee
Texas	*11,671	-	-	11,671	-	-	-	-	10,296	-	10,296	Texas
Utah	-	-	-	-	-	-	36	-	-	-	36	Utah
Vermont	-	-	1,759	1,759	10	-	-	-	-	-	-	Vermont
Virginia	4/ 267	-	-	267	-	-	26	-	-	9	35	Virginia
Washington	*6,495	1,550	11/ 97	8,142	-	-	-	11/ 1,005	-	-	1,005	Washington
West Virginia	(4/)	-	-	-	-	-	-	-	-	-	-	West Virginia
Wisconsin	7,069	1,109	-	8,124	205	-	4,009	-	-	-	4,009	Wisconsin
Wyoming	646	-	-	646	-	-	-	-	-	-	-	Wyoming
Dist. of Col.	-	8,704	-	8,704	-	8	554	-	-	-	562	Dist. of Col.
Total	200,613	65,124	11,880	277,617	8,261	2,850	74,148	39,716	36,873	7,786	161,413	Total

1/ Includes receipts from motor-fuel taxes, motor-vehicle fees and fines, and special imposts on motor vehicles operated for hire (motor-carrier taxes). See tables G-3, MV-3, and MC-2, which give distribution of receipts separately.

2/ Amounts distributed during the calendar year often differ from actual collections because of undistributed funds and lag between accounts of collecting and expending agencies.

3/ Includes expenses of collection and administration of motor-fuel tax, motor-vehicle fees, and motor-carrier taxes, and miscellaneous expenses of motor-vehicle regulation.

4/ The following allotments for construction and maintenance of county roads under state control are included in state highway purposes: Delaware, $909,000; North Carolina, $10,238,000; Virginia, $7,000,000; West Virginia, $8,094,000.

5/ Reimbursement to local units of government for amounts spent on roads now on state system.

6/ In states indicated by star (*) law provides that these funds may also be used for service of local highway obligations, amounts so used not reported separately. In Colorado funds may be used on both state and local roads.

7/ This column shows specific allotments for city streets. Where reported separately, funds allotted for urban extensions of state highway system are included in allotments for state highway purposes.

8/ To state general funds except in the following states: Alabama, county and municipal general funds; California, general funds of counties and cities, $3,827,000; New Mexico, county general funds, $500,000; Wisconsin, towns, cities, and villages in lieu of personal property tax formerly imposed on motor vehicles, $3,857,000. Allocations to local general funds may have been used in part for highways, but such amounts not reported.

9/ For the following purposes: Arizona, irrigation engineering expenses; Delaware, beach protection; Florida, aviation; Louisiana, harbor improvement; New Jersey, service of institutional construction bonds, $520,000, and department of commerce and navigation, $265,000; North Carolina, state probation commission; Ohio, hospitalization of indigent persons injured in motor-vehicle accidents; Oklahoma, service of general state debt; Pennsylvania, aircraft landing fields, $451,000, and cooperative work other departments, $51,000; South Dakota, payments on real estate bonds; Tennessee, debt service on non-highway bonds; Virginia, aviation.

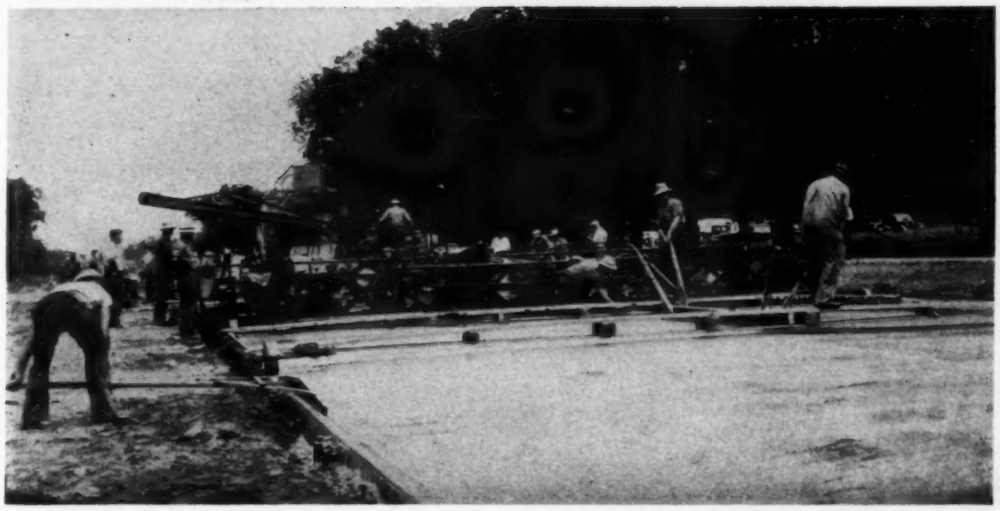
10/ Legislative restorations from proceeds of sale of general state bonds were applied to debt service payments, thus reducing amounts necessary from current revenue.

11/ Includes debt service charges on emergency relief bond issues prorated in proportion to use of proceeds for state highway, local road, other highway, and non-highway purposes.

12/ Service of highway relief bonds, a state obligation incurred for improvement of local roads.

13/ Appropriations for highway purposes out of state general fund have been credited against payments of motor-fuel tax and motor-vehicle fees to the general fund and prorated in proportion to net receipts not otherwise dedicated.

13/ Amounts previously loaned to general fund for relief purposes entirely repaid during 1937.



A General View. At left the luter (not looter) at end of a stroke. Then from front to rear—Bull Floating from Double Bridge, Joint Installer, Finisher and Mixer.

PAVING OPERATIONS BETWEEN JANESVILLE AND BELOIT

By JOHN C. BLACK
Field Editor, Roads and Streets

AS A follow-up of a visit to the reconstruction job on U. S. Route 51 between Beloit and Janesville, Wisconsin, a general account of which appeared in the August issue of ROADS AND STREETS, I made the trip again on August 24 to look at paving operations.

Contractor J. R. Griffith, I found, had progressed well from Beloit north, and was going at a rate of about 750 ft. of 3-lane pavement per day except when interrupted by bad weather. No concrete had as yet been laid at the northerly end of the project.

Carr Formgrader at Work. In the Background, an RD-7 Cat with a 9-Yard Le Tourneau Scraper is making some final grade adjustments

Traffic to Be Accommodated by the Three Lanes

The Wisconsin State Highway Commission found an annual 24-hour average of 2,082 vehicles on this section of road, but felt that this was somewhat below normal because a portion of the regular traffic presumably had used other routes at times during the count, in order to avoid construction work, although the road was not closed to traffic at any of these times.

As the average ratio between average and peak traffic for 24-hour periods varies from 200 to 500 per cent, it was estimated that this portion of U. S. 51 would carry from 4,500 to 5,000 vehicles as a 24-hour peak—a number in excess of the maximum capacity of a two-lane highway for rapid, safe and comfortable traffic; hence the decision to install three lanes.

Traffic counts north of Janesville show somewhat less than between Janesville and Beloit, indicating that a good deal of the traffic is of intercity character; and it was felt that barring entirely unexpected developments, a 30-ft. pavement should serve this traffic adequately for a very long period. The previous statement that a fourth lane is contemplated was in error.

Widening Began in 1935

The first work on the 30-ft. pavement south of Janesville was done in 1935 by A. E. Bounsall of Kenosha, who paved 2.64 miles to a 30-ft. width. Subsequent to that time several contracts were let, embracing grading operations and certain structural work, anticipating the future paving of the entire project to a width of 30 ft. Contracts for completing all grading and structures and

The Koehring Double Drum 34-E Paver Receiving a 37.4 Cu. Ft. Batch (each truck carried two batches) from One of Friedrich & Philipp Co.'s New Internationals.

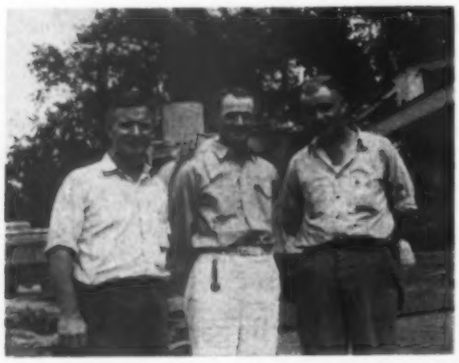
the laying of a 30-ft. pavement over the remaining gap of 8.55 miles were let in the spring of 1938.

Lest there be confusion over distances, it may be mentioned that the Bounsall contract of 1935 included a short stretch inside the Janesville city limits, while the present Griffith contract extends into Beloit approximately 1½ miles.

Costs

The entire project begun in 1935 and now on its way to completion totals 11.20 miles, under contracts aggregating $572,483, or $51,115 per mile. Major items are as follows:

Excavation	$ 28,415
Borrow	76,355
Removing old pavement	9,241
Concrete pavement	301,850
Concrete sidewalk	10,947
Subway under railroad	37,096
Bridges and culverts	57,863
Other items	50,716
Total	$572,483



Left to right: W. A. Piper, Paving Inspector; W. A. Sanborn, Resident Engineer; R. V. Thiel, Pavement Inspector. All three were camera-shy but their resistance finally broke. Contractor Griffith, who was also shy, escaped.

A summary of J. R. Griffith Company's contract for 4.752 miles, now in progress, is as follows:

Item	*Unit*	*Quantity*	*Unit Price*	*Amount*
Clearing	In.Dia.	2,784	$ 0.19	$ 528.96
Grubbing	In.Dia.	2,634	0.22	579.48
Remov. Old Culv.	L.S.	1	19.00	19.00
Remov. Conc. Pavement	S.Y.	35,919	0.119	4,274.36
Remov. Conc. Curb	L.F.	2,286	0.08	182.88
Remov. Conc. Sdwk.	S.Y.	56	0.12	6.72
Common Excavation	C.Y.	31,056	0.253	7,857.17
Borrow Excavation	C.Y.	11,992	0.274	3,285.81
Fine Grading	C.Y.	150	0.20	30.00
Shoulder Embankment	C.Y.	98	0.30	29.40
Finish. Roadway	Sta.	266	8.85	2,354.10
Concrete Pavement	S.Y.	80,136	1.558	124,851.89
Concrete Headers	S.Y.	130	5.00	650.00
Structural Steel	Lb.	3,140	0.10	314.00
Gr. Tr. Bd. Surf. Course	C.Y.	5,608	0.85	4,766.80
Re. Conc. C.P. 24 in.	L.F.	544	3.46	1,882.24
C.G.S.M.C.P. 18 in.	L.F.	1,838	1.80	3,308.40
C.G.S.M.C.P. 24 in.	L.F.	486	3.20	1,555.20
C.G.S.M.C.P. 30 in.	L.F.	92	4.00	368.00
C.G.S.M.C.P. 36 in.	L.F.	38	4.90	186.20
Sal. Conc. C.P. 24 in.	L.F.	60	2.10	126.00
Riprap	L.F.	363	2.80	1,016.40
Re. Conc. C.P.S.S. 12 in.	L.F.	140	1.70	238.00
Re. Conc. C.P.S.S. 18 in.	L.F.	106	2.40	254.40
Catch Basin	Each	1	118.00	118.00
Catch Basin	Each	1	90.00	90.00
Inlets "A"	Each	33	38.40	1,267.20
Inlets "B"	Each	1	52.00	52.00
Adjust. Manh. C.	Each	21	4.60	96.60
Conc. C. & G. 30 in.	L.F.	4,287	0.84	3,601.08
Conc. Sdwk. 5 in.	S.F.	66,460	0.151	10,035.46
Conc. Sdwk. 6½ in.	S.F.	4,345	0.21	912.45
Marker Posts	Each	82	1.50	123.00
Top Soil for Planting	C.Y.	11,777	0.355	4,180.84
Seeding	S.Y.	81,568	0.015	1,223.52
Sodding	S.Y.	11,581	0.20	2,316.20
Conc. Steps	C.Y.	2	39.00	78.00
Total				$182,759.76

Pavement Characteristics

The new 30-ft. slab is 8 in. thick, tapered over the outside 2 ft. to make 10 in. at the edge. The crown is a 2⅝-in. hyperbola. There is no reinforcement except the ordinary edge and corner bars. Transverse joints of ¾-in. bituminized felt with metal expansion shields are installed at 100-ft. intervals, with dummy joints at the 25-ft. points between. Longitudinal dummy joints of

A General View of Operations between Paver and Finisher. The two Roeth vibrators are clearly shown, the operator being at work in the left foreground of the picture.

asphalt-treated ribbon divide the pavement into 10-ft. lanes. The surface is brush-finished for texture.

The concrete mix requires 1.35 bbl. cement per cubic yard of finished concrete. Water is not allowed to exceed 5.4 gal. per sack of cement. The standard batch of 37.4 cu. ft. contains—

Cement	703 lbs.
Sand (dry wt.)	1586 lbs.
¼-¾-in. stone (dry wt.)	1272 lbs.
½-1½-in. stone (dry wt.)	1915 lbs.

Water in the aggregate varies, but commonly averages 11 gal. per batch, in which case 29 gal. is added at the mixer to make the necessary 40 gal. total.

Construction Operations

The aggregate plant and supply were described briefly in the previous article. The crusher produces about 60 cu yd. per hour, and as the big mixer uses approximately twice that much, the plant would have to operate 16 hours a day were it not for the large stock piles accumulated before paving began and the fact that an occasional rainy day gives a chance to catch up.

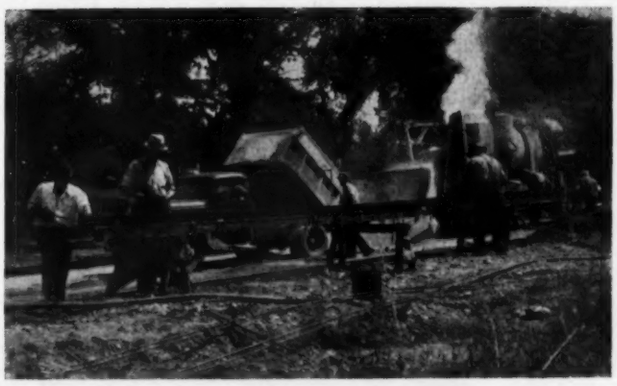
Proportioning and Hauling

Aggregates are delivered by a crawler-mounted crane to two Butler bins from which they are proportioned directly into the trucks.

All hauling is done by Friederich & Philipp Co. of Oshkosh, Wisc., specialists in dump trucking, who at the present time are operating 62 trucks on 4 different jobs. On this contract they have thirteen 3-ton Internationals covering the two-mile haul from plant to mixer. However, sideboards have been added and each truck regularly carries two batches aggregating 5½ tons. Mr. Friedrich informed me that 8 trucks would have sufficed to supply a 27E paver. The batches are separated by a simple tilting cross board.

Mixing and Placing

Paving was started on August 2, with a Koehring double drum 34E paver, using a 33-cu. ft. batch. Wisconsin specifications permit a 10 per cent overload on this type of mixer, but the contractor chose not to attempt working at this limit until his crew became somewhat familiar with the new machine, and his routine adjusted to it. On August 12 the batch was increased from 33 cu. ft. to the full 37.4 cu. ft. permitted, and this increase has been continued ever since.



Assembling a Transverse Joint.

The average run per full 8-hour day up to the time of my visit was 750 lin. ft. of 30-ft. pavement. The maximum single day was 824 ft., made on August 11, the last day on which the 33-cu. ft. batch was used. Weather and other conditions since then have slowed production, the most serious delays, I am informed, being due to subgrade troubles, which have cost an average of approximately one hour daily. While I did not get at

A Transverse Joint in Place—Vibrator at Work in Left of Picture—Idle Vibrator on Opposite Side Near End of Joint. Note the paving crew's cars parked in background.

International Trucks Loading Two Batches Each from Butler Bins at Aggregate Plant.

the cause as fully as I should have liked, I judged that better primary finishing would have done much to better conditions. A good deal of sand was used to even up and fill low spots. It was compacted with an old Fordson roller. The forms (Metaforms, made by the Metal Form Corporation of Milwaukee) were set in trenches cut with a Carr Formgrader well in advance of pouring operations.

Numerous low-strung electric service wires across the road were a cause of minor delays, as the paver skip would not clear them in its elevated position, and the most favorable placing of the paver was therefore at times impractical. Occasionally it was necessary to call linemen to move the wires.

Concrete was well distributed from the mixer bucket across the 30-ft. width, with only a moderate amount of hand spreading necessary. When not delayed by causes such as mentioned, the mixer turned out about 70 of the 37.4-cu. ft. batches per hour.

Finishing

After the concrete is placed, it is thoroughly vibrated along the forms and on each side of the transverse joints, two wheelbarrow-type machines made by the Roeth Vibrator Co. of Chicago, being used for the purpose. These appear clearly in some of the pictures. One operator does all the vibrating without, apparently, being overworked or crowded for time; and it is interesting to remember that not so long ago we used to see two men on one vibrating machine instead of one man on two. The use of two units—even though one is always idle—saves man-power and presumably results in better work.

The Jaeger Lakewood finisher appears clearly in several of the pictures. I found it operating smoothly and effectively. Following it comes the Flexible Road Joint Machine Co.'s joint installer, from which the two longitudinal ribbon joints and the temporary transverse dummy joint strips are placed. It, too, was operating satisfactorily.

Hand operations include longitudinal floating, luting, belting, joint and edge finishing, and surface roughening. As shown in the picture, this last is done with a long-handled stiff brush after initial set has started.

A View of the Mixer from Opposite Side.

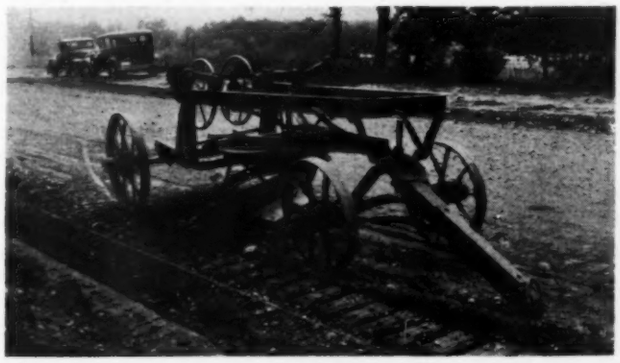
Jaeger Lakewood Finisher and Flexible Road Joint Machine Co.'s Joint Installer at Work.

Putting on the Texture.

Curing, which is sub-contracted, is done with special paper covers, sprinkled as necessary. When the curing period is complete, the paper strips are rolled up and carried forward to be used again. I regret that I failed to learn either the name of the curing contractor or the manufacturer of the paper.

Incidentally

Two things about the job particularly impressed me—the generally superior types of men comprising contractor Griffith's crew, and his effective use of equipment which was far from new. On the former point, my wife, who accompanied me on the trip, having emphatically confirmed my judgment, I know it must be right. In the plant there was little which had been bought this year except the paver and batch trucks, yet all seemed working as it should.



This Old Timer (does it look familiar?) was used for miscellaneous subgrade trimming, and appeared entirely adequate for the work.

▼

British Census of Road Traffic—During August the Ministry of Transport by Great Britain in collaboration with local road authorities took the triennial census of traffic on Class I roads in Great Britain. The roads of this class outside of the London County Council area aggregate a total of some 27,000 miles and that about 12,000 enumerators, working in relays, noted the class and weight of all vehicles passing the alloted census points. At some 500 selected points this traffic account was continuous throughout the 24 hours. The last census taken in 1935 showed that the number of vehicles, other than pedal cycles, had increased by over 34 per cent during the previous three years. In the same period, pedal cycles showed an increase of 95 per cent.

BOOK REVIEW

A British Official Speaks on Traffic and the Road

"Road Traffic and Its Control," by H. Alker Tripp, Asst. Commissioner of Police, Scotland Yard, London, in charge of traffic. 414 pp. Price $10.00. Publication date July 20, 1938. Longmans, Green & Co., 114 Fifth Ave., New York City.

The author of this important book has had a very wide experience in all aspects of the traffic problem. The work will appeal to readers of several different types. Local authorities, who are primarily responsible for the control of traffic, will find it a valuable synopsis of what has been thought and done. It will serve as a lucid and amply cross-referenced text-book for police officers. Lastly, and most important to the readers of Roads and Streets, it will be of great practical value to those who design and build roads.

The author's explanations are supplemented by numerous clear illustrations, mostly in the form of street layouts and highway intersection diagrams, with a number showing methods of traffic control for modern conditions.

As a cyclist for forty years, a motorist for thirty, and one who still, during his studies of traffic at home and abroad, performs a considerable mileage on foot, the author thinks himself reasonably free from bias. In view of the intricacy of the subject—which involves not only vehicles and roads, but law (necessarily in the main, British), public opinion, psychology and town planning—he regards dogmatism as misplaced; his object is not advocacy, but exposition.

The book is divided into the following eight parts:

1. General Considerations—The Traffic Problem.
2. Traffic Control by Law and Police.
3. Development of Traffic Policy.
4. Traffic Control by Construction and Mechanical Appliances.
5. Road Government and Administration.
6. Road Transport.
7. Statistics (Methods of preparation and presentation).
8. Road Casualties.

Part 4—Construction and Appliances—contains 154 pages, under the following chapter and major section heads:

(a) The Road
Objects, Capacity.

(b) Items of Road Layout and Equipment
General, the Carriageway (that part of the roadway surfaced for traffic), Cycle Tracks, Footpaths and Foot Crossings, Access and Amenities, Road Junctions and Intersections.

(c) Traffic Signs and Signals

(d) Planning of New Roads
Main Principles and General Applications, Traffic Arteries, By-pass Roads, Distributive and Minor Roads, Linkage of Arterial and Other Roads, Main Shopping or Business Streets, Special Types of Roads, Tunnels, Accommodation for Waiting Vehicles.

(e) Adaptation of Existing Roads
Road Junctions, General Considerations, Roads in Towns, Roads in Country and Suburban Areas.

(f) Town Planning.

▼

Road and Bridge Construction in Philippines—An expenditure of $48,000,000 is provided in the public works program passed recently by the National Assembly of the Philippine Islands. Of this sum $25,000,000 is for roads and $3,000,000 is for bridges. The expenditures are to spread over 4 years beginning in 1938.

OBSERVATIONS BY THE WAY

By
A. PUDDLE JUMPER

¶ Down in Albuquerque, New Mexico, I saw something that might be of interest. The river was washing close to a bridge abutment. To protect it a groin was built of old automobile bodies. They were placed in a straight row at equal depth and I believe will do the job expected to be done—catch drift and cause deposit.

• •

¶ Somehow or other, everytime I hit Maryland I cannot help but feeling sorry for the folks who have to risk their lives on those obsolete roads.

• •

¶ It's been a mystery to me why our bridge engineers have not insisted on higher strength steels from the steel industry.

• •

¶ We think we're designing economical bridges. I think bridge engineers are wasting public funds. They still use 16,000 lb. per square inch for design except for certain members or conditions where they allow 18,000. The yield point is up near 35,000 lb. and the maximum stress near 70,000 or 75,000 lb. per square inch. With developments in inspection and shop fabricating practice considerably advanced over Civil War time practices, it seems to me our designers are asleep, because they still use the stress figures twice too low.

• •

¶ Why haven't our bridge engineers demanded a rust proof steel?

• •

¶ Why hasn't some value been allowed on bridges, both concrete and steel, for the fact that when they are completed they act as a unit rather than as an assemblage of individual members? Instead of bridges having a factor of safety of 4, when completed, this factor of ignorance is nearer to 16 to 1 than 4 to 1.

• •

¶ I met Bernard Gray, Chief Engineer of the Asphalt Institute, in front of the Commodore Hotel in New York the other day. We talked some about the inability of getting research information and new equipment developments widely disseminated, quickly. There's too long a lag between new developments and practice. What do you suggest to overcome this lag?

• •

¶ Diversion is still a malignant cancer in the highway field. Batter down on it every chance you get. Write about it to your local, town or county newspaper editor. Tell him why it should be eliminated.

• •

¶ What shows the value of improved highways better than flood or hurricane conditions? Note how they served both California and New England.

• •

¶ Did you ever see a snow plow slam into a hillside slip where mud, muck, gravel, and debris to a depth of 3 feet had washed over the highway? That's the way the Teconic State Parkway commission in New York State cleaned off the surface after recent rains. The truck would back up, take a run, and slam into the mass. The dirt certainly flew and the slab was cleaned off in a short while. Sorry my camera had no film.

• •

¶ When does a chicken play in a band? When it gets its corn et.

• •

¶ In Indiana stabilization has gone high hat. They just finished a job that cost almost as much per square yard as concrete.

• •

¶ North of Springfield, Illinois, I traveled the main road headed for Chicago, in the rain. On both sides of the road at about 100-ft. intervals were those fish eye reflector discs mounted on iron pipe posts. My headlights showed these up for a quarter of a mile or more ahead. They had a subconscious effect of security on my driving. I certainly missed them after I got out of the strip.

• • •

I Like Discussions

I like discussions. The name doesn't matter much—forum, panel discussion, round table—though "seminar" sounds the least bit suffy, like going into a long-closed schoolroom.

I like discussions, as much for what they disturb as for what they settle.

I like them because, by studying the differences of opinion they produce, I can tell whether a person is thinking or, in the old phrase, is only rearranging his prejudices.

I like discussions because differences of opinion are interesting for their own sakes.

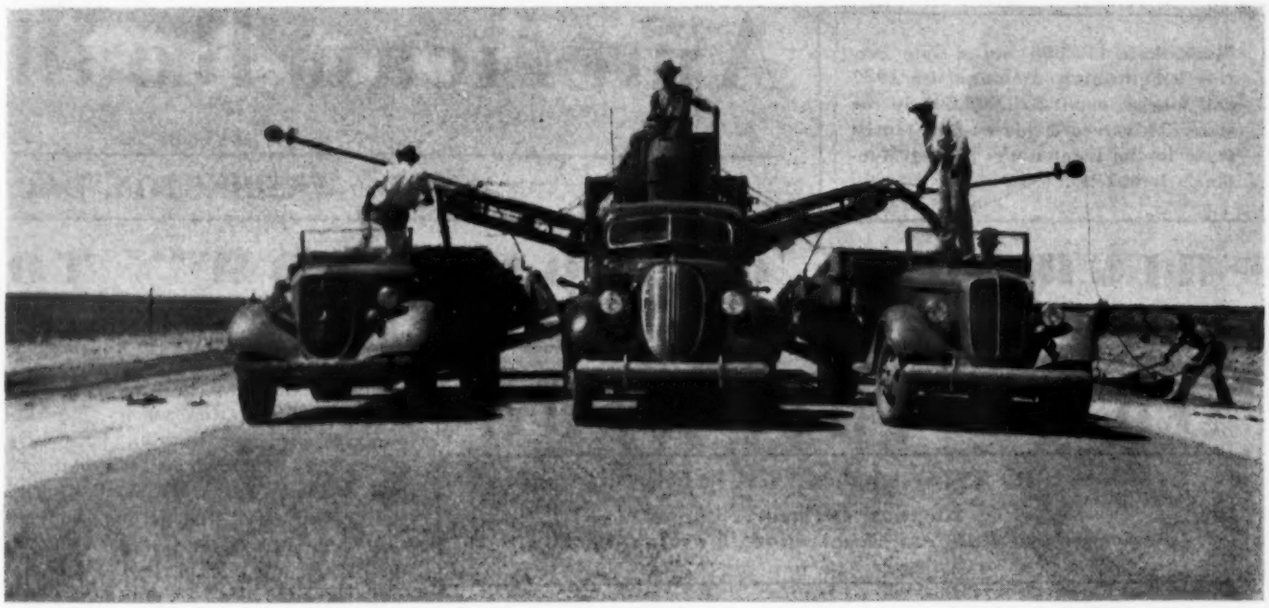
I like discussions not only because I have no quarrel with differences, but because they may save me from quarrels with people.

I like discussions because they help me to tolerate opinions that I can't accept.

I like discussions because they force me to face new facts and arguments which might weaken my own case.

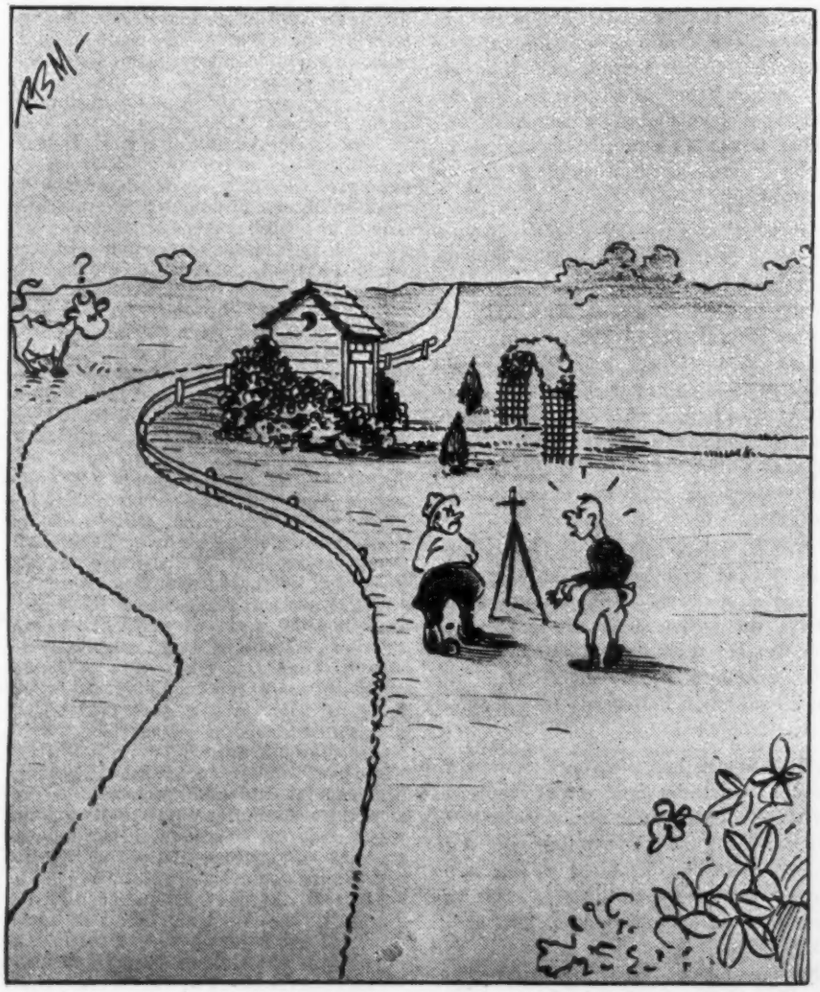
I like discussions because they save me from being too sure of those notions of mine that are supported by too few facts or too thin argument.

I like discussions because they give me a chance—which I greatly enjoy—of trying to state the other man's case even more persuasively than he does.—*Justus Timberline, from the ASTM Bulletin.*



¶ The picture above shows the rig that Public Construction Company is using on bituminous surface treatment work in Texas. W. M. Jagoe is president of the company. Their headquarters are in Denton, Texas. Chips are stock-piled along the shoulders in predetermined quantities. The machine is mounted on a truck chassis and by a series of belt conveyors, loads the spreader mounted trucks.

Jagoe also has devised a car unloader similar in part to this outfit. Speed is the feature of both units. Jagoe averages 500,000 gal. of asphalt a month with these rigs.



Th' Chief says, "beautify all familiar local landmarks"—"Mississippi Highways."

The Genesis of the Road

One day through the primeval wood
A calf walked home, as good calves should,
But made a trail, all bent askew,
A crooked trail, as all calves do.
Since then two hundred years have fled,
And I infer the calf is dead;
But still he left behind his trail;
And thereby hangs my moral tale.

The trail was taken up next day
By a lone dog that passed that way;
And then a wise bellwether sheep
Pursued the trail o'er vale and steep,
And drew the flock behind him, too,
As good bellwethers always do;
And from that day, o'er hill and glade,
Through those old woods a path was made.
And many men wound in and out,
And dodged and turned and bent about,
And uttered words of righteous wrath,
Because 'twas such a crooked path.
But still they follow (do not laugh)
The first migrations of that calf.

This forest path became a lane,
And bent and turned and turned again;
This crooked lane became a road,
Where many a poor horse, with his load,
Toiled on beneath the burning sun
And traveled some three miles in one—
And thus a century and a half
They trod the footsteps of that calf.

The years passed on in swiftness fleet;
The road became a village street,
And this (before men were aware)
A city's crowded thoroughfare,
And soon the central street was this
Of a renowned metropolis,
And men, two centuries and a half,
Trod in the footsteps of that calf.
Each day a hundred thousand rout.
Followed the zigzag calf about,
And o'er his crooked journey went,
The traffic of a continent,
A hundred thousand men were led
By one calf, near three centuries dead.

—Sam Walter Foss.

From the North Dakota Highway Bulletin.

More than 417,000 out-of-state cars traveled through Montana in 1937 and tourists spent $28,000,000 in the state. This record places the tourist trade in the front ranks among Montana's industries.

American Road

WASHINGTON, D. C.

"HIGHWAYS OF TOMORROW" TO

Down the Road

By CHARLES M. UPHAM
Engineer-Director,
American Road Builders' Association, Washington, D. C.

THE HURRICANE AND THE HIGHWAYS

I have traveled in the wake of a hurricane. I have seen death and destruction in New England. I also witnessed the way in which highways withstood that terrific blast and I want to tell you of the admirable part they played in bringing help and restoring order.

The village where I used to live sustained considerable mutilation and I was, of course, first of all concerned with the safety of my people and the extent of the damage to the places I knew as a boy. But I could not help but interest myself in the effect of the hurricane on the highways. Fortunately, there were no lives lost in our village, though many homes were smashed and trees uprooted everywhere, many of them 100-year-old elms, two to four feet in diameter.

Although the highways were at first completely blocked by fallen trees, they were cleared within a few hours and were soon in full use again by traffic, despite the worst storm New England has ever experienced. The ability of the highways to cope with this situation made possible the transportation of food and medical supplies and prevented the deprivation in towns and smaller communities which so often follows major disasters.

Train service between New York and Boston was interrupted and the railroad had to resort to buses and the highways to complete its schedule. On my trip, I was carried by train through New Haven to Saybrook, Conn., thence by bus over Connecticut highways to Westerly, Rhode Island, and then by rail again from Westerly to Boston. This is a very definite example of variable advantages and the value of highway transportation even in extreme emergencies.

Without the highway systems of New England functioning as they did in short order after the fury of the hurricane had subsided, considerably more people would have been thrust into destitute circumstances and many would have undoubtedly perished from want of food and need of medical attention. But the highways did not fail in their duty as public servants. They speeded up restoration and decreased human suffering!

Except where the whole countryside was flooded and in the few instances where a road was completely washed away, the entire highway transportation system was available for 100 per cent use only a few hours after the hurricane had delivered its heaviest lick.

This is another instance of the universal assistance and great value of our highway transportation system. The highway engineer who is laboring with the present-day problem of relieving congestion and providing a highway system that will adequately and at all times render benefits to all people will find the service record of New England's hurricane-proof highways valuable indeed.

"Highways of Tomorrow" will keynote the 36th annual convention and highway exhibit of the American Road Builders' Association when that organization meets in San Francisco, March 7-10, 1939. The road builders' first conclave in the West will be held concurrently with the national convention of the Associated General Contractors of America. Charles M. Upham, engineer-director of the American Road Builders' Association, and Edward J. Harding, managing director of the Associated General Contractors of America, pointed out that the concurrent meetings of the two associations will bring together representatives of the highway industry and profession from all parts of the nation, especially the western states, and will help immeasurably to solve many problems of the highway program.

The highway exhibit of the American Road Builders' Association will be held in the Civic Auditorium and visitors will have an opportunity to see and compare the newest developments in road-building equipment and materials. There has probably been no other period in the history of road building when as many radical changes have taken place as in the past few years.

The theme of the entire ARBA convention will be "Highways of Tomorrow," Mr. Upham explained, and the exhibits will show the equipment and materials that will be used in the highways of tomorrow. The United States Bureau of Public Roads, the United States Department of Commerce and several of the western states will stage educational exhibits. A large number of models of equipment will be on display and models of highway design will demonstrate some of the ideas for our highways of the future.

Plans are being negotiated for jointly carrying out part of the ARBA convention program with the Highway Research Board. Under this arrangement the research organization would have jurisdiction over that part of the program concerning research.

All current highway topics will be discussed during convention sessions and reports and addresses will be presented by the nation's outstanding highway leaders. There will be a large number of visitors from the Central and South American countries.

Dates of the convention and highway exhibit of the American Road Builders' Association are two weeks after the opening of the Golden Gate Exposotion —the "travel fair" of the West. Delegates to the convention will have ample opportunity to visit the fair.

Builders' Review

SEPTEMBER, 1938

Of 200 cars checked by Governor Jensen during a drive over one of the South Dakota highways, only 24 carried South Dakota license plates. Eighty-eight per cent of the cars belonged to visitors to the state.

KEYNOTE A. R. B. A. CONVENTION

With Our State Groups

MASSACHUSETTS

The quarterly meeting of the Massachusetts Highway Association on September 15 took the form of an inspection tour of the Worthington Pump and Manufacturing Co. at Holyoke. This trip was followed by an old-fashioned clam bake at Smith's Ferry on the Connecticut river near Holyoke. Road builders in Massachusetts are expected to have a busy fall season, as more than twenty-five projects have been or are about to be placed before contractors for consideration. The state legislature, which was prorogued in mid-August after the longest session in its history, provided that the balance of $5,000,000 remaining from the annual gasoline tax should be placed at the disposition of the cities and towns of the commonwealth for highway purposes. While it is almost too late to expend this money to advantage this season, the provision marks a victory for the anti-diversion forces and the contest for the adoption of the proposed anti-diversion amendment will be carried on with resumed vigor during the next session.

OHIO

The opportunity afforded by PWA for state highway and county road improvement programs was discussed at a meeting between Ohio road builders and PWA representatives in Columbus on September 2. L. A. Boulay, administrator of PWA in Ohio, detailed the rules governing the handling of the sponsors and government funds and explained the type of work that would be considered a proper PWA project. A joint meeting of the County Engineers' Association of Ohio and the Ohio County Commissioners' Association was held in September, with Mr. Boulay again acting as speaker. As a result of these meetings, it is reported that the state highway department will submit a substantial program, totaling about $15,000,000 and the sixty counties will submit projects whose total should equal that of the state highway department.

"UNCLE JIM" MAC DONALD DIES

James H. MacDonald, "father of American good roads," died September 22, in New Haven, Conn., his home, at the age of 87. "Uncle Jim," as he was known to his thousands of friends and admirers throughout the United States, was one of the country's pioneer highway engineers and one of the original sponsors of the federal highway system.

The first highway commissioner of the state of Connecticut, he served in that capacity from 1897 to 1913. He was the first road builder in the state to plan highway construction with regard to a state system of trunk lines and state-aided town roads and to him belongs the credit for the development of the Connecticut road system from muddy thoroughfares in 1897 to a systeem of stone-built paving on through routes and gravel roads in towns and cities. He instituted a system of farm-to-market roads that became a model for such construction throughout the nation and made him popular throughout the country and in Europe as a speaker on the subject.

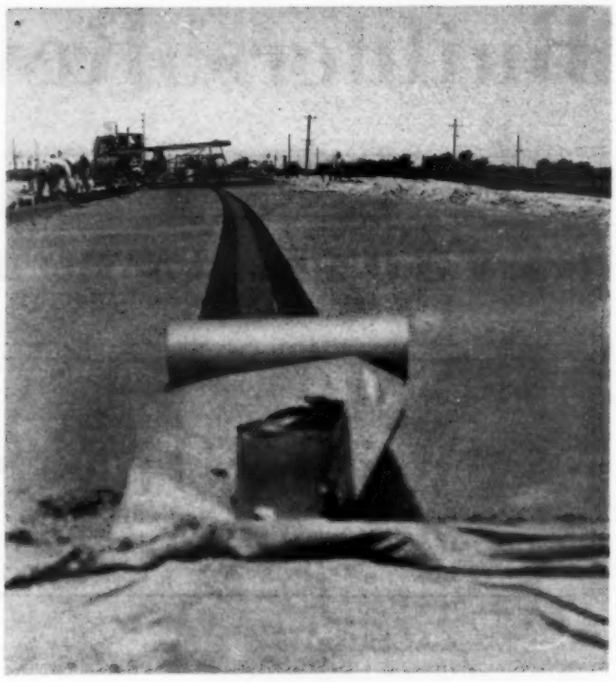
Charter member and treasurer of the American Road Builders' Association, "Uncle Jim" had taken an important part in all the association's meetings until ill health forced him to miss the 35th annual Convention and Road Show of the organization in Cleveland in January of this year. For many years he had served this group as president and became treasurer in 1918. As a token of their esteem, ARBA members in 1928 presented him with $1,000 in gold at the annual convention in Washington. The American Road Builders' Association, the Highway Research Board and the American Association of State Highway officials jointly presented him with the George S. Bartlett Memorial Award in 1933 for his contribution to highway construction. In his later years he maintained an office of his own as a consultant in road building and its allied interests.

His chief interests, in addition to road building, included children and flowers. His side yard was a show place in the city each summer as he cultivated a huge garden of flowers and plants of all types. He was famed as a host to all the children in the neighborhood and always had a bright penny to present to his young friends. Each year children from a near-by school thronged his home for a Christmas party.

Funeral services for the veteran were held Monday afternoon, September 26, in New Haven. The Washington offices of the ARBA were closed for a half day as a mark of respect for his passing and Charles M. Upham, ARBA engineer-director, with other members of the Washington staff, attended the funeral.

CONSTRUCTION OF PAVEMENT APPROACH TO GALVESTON CAUSEWAY

Two-Color Built-In Traffic Stripe a Feature



Completed Traffic Stripe.

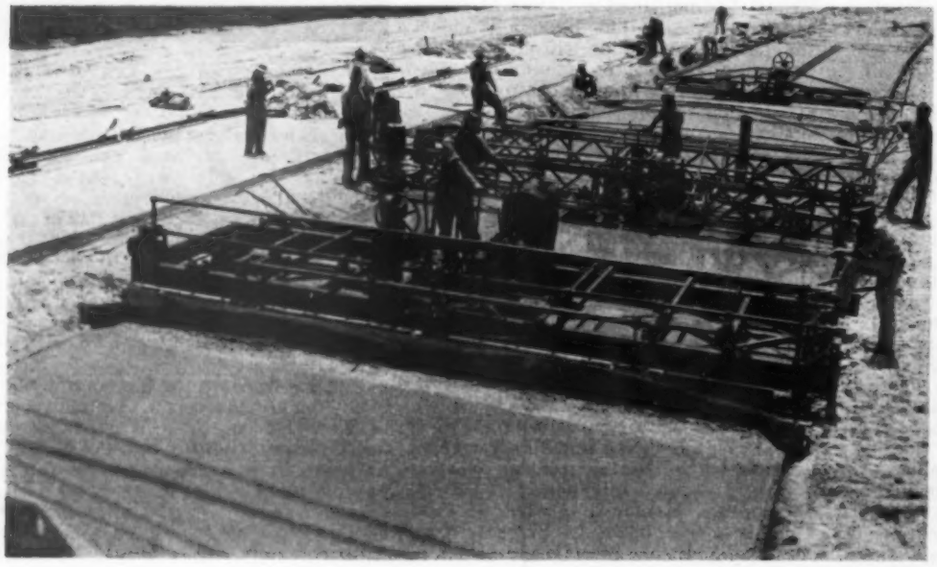
THE accompanying pictures clearly illustrate some of the interesting construction features of the approach on the island side of the new causeway connecting Galveston, Texas, with the mainland. The work was carried out as a Federal Aid Project under the direction of the Texas State Highway Department, and was completed during the months of July and August in a total of 33 working days. Froemming-Kies, Inc., of Austin, Texas, were contractors for the entire project, Mr. G. H. Kies being in direct charge.

Pavement Characteristics

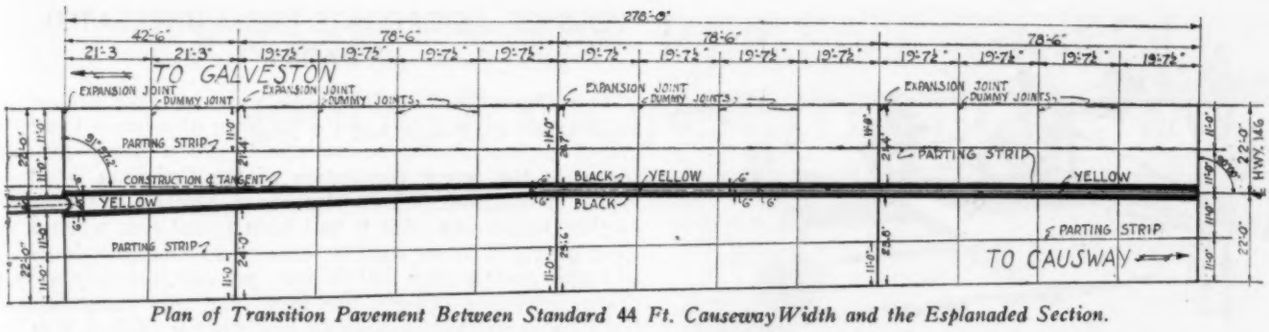
Pavement on the causeway is 44 ft. wide (4 unseparated 11 ft. lanes); but the approach comprises two 22-ft. roadways separated by an "esplanade" from 4 to 10 ft. wide, which will be planted with oleanders—the brilliant ornamental shrubs for which Galveston is famous. Slabs for the separated roadways are constructed 22½ ft. wide, the inner edge of each being covered by a 6-in.x6-in. integral monolithic curb.

A transition section 278 ft. long intervenes between the standard 44-ft. section and the esplanaded approach. Other irregularities occur at two large intersections with other roads. There is a 13-ft shoulder on each side, both shoulders and slopes being covered with 6 in. of compacted shell—a local material which long ago proved its value as a surface protection for sand under Galveston conditions.

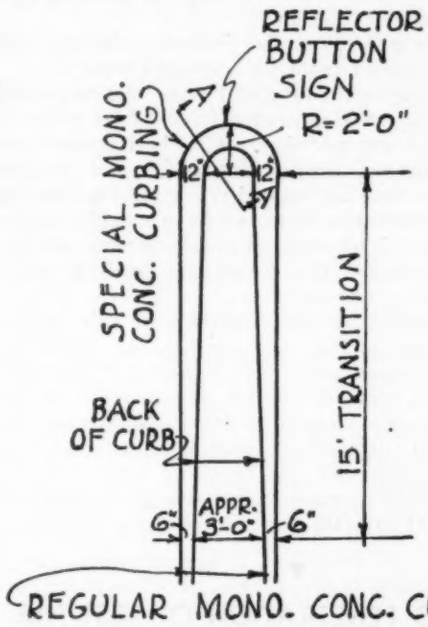
The Froemming-Kies contract for approach paving included 17,499 sq. yd. of 10-7-10 reinforced concrete



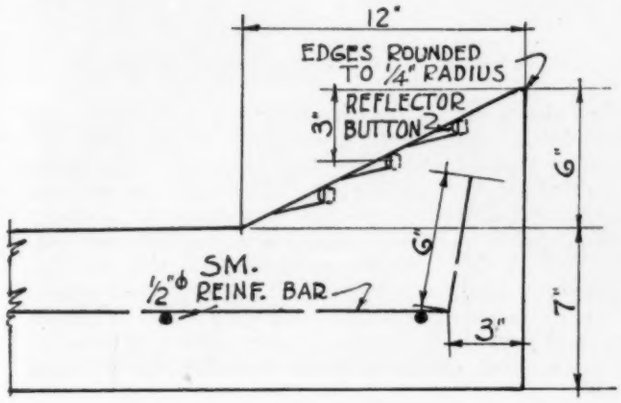
From Front to Rear—Finishing Machine, Joint Installing Machine, and Traffic Striping Machine. Float and Belt May Be Seen Between the Two Latter. Back of the Striping Machine, the Finished Stripe Is Visible.



Plan of Transition Pavement Between Standard 44 Ft. Causeway Width and the Esplanaded Section.



Plan Showing Curb at Beginning of Esplanade. Farther on, the width of esplanade is increased to 10 ft.

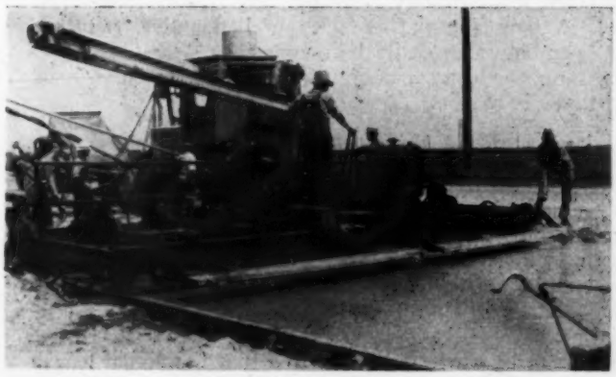


Section A-A Through Special Curb.

slab. The cement factor was 4 sacks per cubic yard, which made a total of 4.8 sacks per 32.4 cu. ft. batch. The approximate bin weights for aggregates were 2,600 lb. of gravel and 1,600 lb. of sand. It was necessary to use 30 lb. of mineral filler with this batch to eliminate bleeding. A workability factor of 82 was used with a minimum of 8¼ gal. of water per sack of cement.

Construction Equipment and Methods

All of the concrete, including transition and crossings, was machine-finished—a Flexible Road Joint Panama type unit being used for the purpose. No special problems or difficulties were encountered on this phase of the work, but there was some trouble in hauling due to the character of the sub-grade material, which was sand pumped from the Gulf. Because this sand was fine and lacked binding quality it was necessary to use single batch trucks in addition to keeping a constant stream of water playing upon the sand to cause compaction sufficient to permit the trucks to travel the shoulder to the paver skip.



Finishing Machine at Work.

The finishing machine was equipped with a cutter to make a preliminary groove for the longitudinal joint. Following it came a Flex-Plane joint installing machine with a rescreeding attachment, then a float and belter, and finally the traffic striping machine. This procession of units shows clearly in the general view.

Expansion joints were installed at 78 ft. 6 in. intervals, with dummy joints on 19 ft. 7½ in. spacing between. Ribbon-type parting strips established the longitudinal planes of weakness between the traffic lanes.

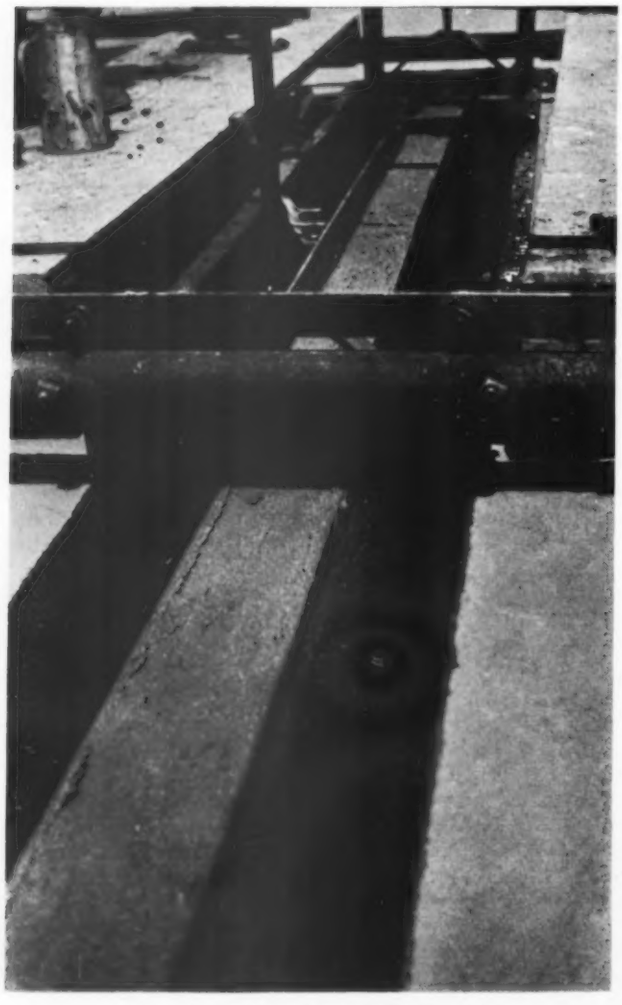
Traffic Stripe

The traffic stripe is 18 in. wide, and consists of a 6-in. yellow band between two 6-in. black bands. Magnetic oxides were used for both colors. The installing machine is hand propelled with an 18-in. wheel and chain drive to the rear axle. All four wheels are flanged to keep it in perfect line. A three-compartment trough 7 ft. long is located in the center of the machine and parallel to the pavement edge. This compartment can be raised by means of a ratchet to permit the operator to move the machine forward.

The first step in making the stripe was to scratch or rake the fresh concrete to a depth of about ⅜ in. Then the dry pigments were deposited from the troughs in their lowered position, and worked into the concrete by hand raking. A float finish completed the job. Since completion, a check with hammer and chisel has shown that the colors were well incorporated to the full re-

The Colored Concrete Traffic Stripe Machine.

quired depth of ¼ in. The stripe constructed by this method has been highly praised for its accuracy and effective appearance. The State Highway Department permitted an alternative method in which the pigment was mixed with water to the consistency of a slurry before application; but it was found that the wet slab provided all the moisture necessary, and that the dry pigment worked better on it. The wide, triple-banded stripe was selected because of the very heavy traffic on this highway. It is said to be more effective than the ordinary single or double stripe in either day or night traffic.



Color Troughs and the Emerging Stripe.

LOSS OF AGGREGATE FROM UNTREATED ROADS

The Department of Highways of the Province of Ontario has given study to the problem of when a loose gravel surface should be improved. In a paper presented at the recent convention of the Canadian Good Roads Association, W. B. Hutchison, District Engineer of the Department, that it had been found that when a loose gravel or stone road is required to carry a volume of traffic greater than 500 vehicles per day, not only are the maintenance charges per mile year very excessive, but it is practically impossible to keep the surface in a standard serviceable condition.

Mr. Hutchison also gave the following information on the loss of material from an untreated road:

"The loss of aggregate or metal from our untreated roads has been variously estimated from ⅓ cu. yd. to 1 cu. yd. yearly per car per day. This loss is not only caused by dusting off during dry spells, but also to blading operations and high-speed traffic. In estimating our probable maintenance costs, we have usually used a figure of ½ a cu. yd. of material yearly per car per day as a gravel replacement, plus a constant roadside maintenance and blading operations.

"To satisfactorily maintain a surface of this nature, carrying an average of 500 cars per day, our actual figures show that it costs between $650 and $750 per mile per year. On our road-mix mulch jobs in this area, we have found, from our past three years' experience, that our average yearly maintenance costs amount to approximately $150 per year. It will be noted from this that our yearly reduction in maintenance charges is approximately from $500 to $600 per mile per year."

▼

RECORDING PENETRATION OF TEST PILE

An ingenious device for determining and recording the penetration of test piles under each blow of the hammer, devised by Lieutenant Commander W. Mack Angus, is described in Bulletin 36, Public Works of the Navy. The method consists of attaching a painted canvas strip to the test pile, on which a line is scribed at each blow of the hammer. The pencil or scribe is guided by a straight edge supported independently of the pile and not, therefore, disturbed by the pile movement. These canvas strips are attached to wood piles by copper tacks and to concrete piles by linoleum cement. In all cases the strips are ripped off the pile a short distance below the scribing pencil as the driving progresses, labeled, rolled up, and taken to the drafting room for study and analysis. Detailed records of penetrations can thus be accurately kept for any desired length of pile. A template marked with predetermined penetrations per blow can easily be matched against the scribed marks on the canvas strip to determine when desired resistance is reached.

▼

ESTIMATING REQUIRED LENGTH OF PILES—An interesting method for estimating the length of piles required for structures has been developed by the Maryland State Roads Commission. A 1-in. double strength iron pipe is driven by means of a 165-lb. hammer falling a distance calculated to develop the same energy per unit of superficial area of pipe as will be developed in the pile by the hammer to be used. It is reported that the actual length of piles driven to the required bearing may be very closely approximated by the above method.

EXAMPLES OF RECENT TIMBER BRIDGE CONSTRUCTION

By FRANK J. HANRAHAN
Structural Engineer,
National Lumber Manufacturers Association

ONE of the most difficult problems currently facing highway officials is that of providing bridges with a capacity commensurate with that of the connecting roadways at a cost that is not prohibitive. Several highway departments have pointed toward at least a partial solution of this problem by building adequate but relatively low cost wood structures.

Modern developments such as the stress grading of lumber, improved methods of drying to eliminate seasoning defects, the treatment of portions subject to unusual decay hazards and the many efficient modern types of joint connections provide greater flexibility in design than has been possible in wood design of the past.

Johnson Creek Bridge

A well designed example of a garden variety of highway bridges is that on the Deardorff Road over Johnson Creek in Multnomah County, Oregon (Fig. 1). This is a five-panel pony truss without outriggers. The span is 60 ft., with a 20-ft. clear roadway width between the wheel guards. It is designed for an H-15 loading. The abutments, which also served the old structure, are of rubble masonry.

All of the Douglas Fir timber in the structure, including the hand rails, was prefabricated and treated with creosote under pressure.

Split ring connectors were used to transfer the load at all joints, as well as for fastening floor beams and lateral bracing to the truss. A laminated wood deck, in which the laminations were cut to form a 2-in. pavement crown, was placed over the timber stringers and a wearing surface of 2-in. asphaltic concrete applied.

All materials, including the treated lumber, hardware, shims, and asphaltic concrete, were delivered to the site for $1,968.95. Multnomah County erected the bridge with WPA labor at a labor cost of $405. The total cost, exclusive of foundation, was $39.58 per linear foot of bridge.

Fig. 1—Sixty-Foot Pony Truss Bridge Over Johnson Creek in Oregon.

Fig. 2—Bridge Over Contoocook River Between Hancock and Greenfield, N. H.

Interesting features of this structure were the elimination of outrigger bracing and uninterrupted traffic flow over the bridge during its construction.

Dinky Creek Bridge

A typical wood bridge somewhat larger than the 60-ft. Johnson Creek Bridge is the 90-ft. structure erected over Dinky Creek, about 60 miles northeast of Fresno, Calif. The location is some 12 to 14 miles east of the main highway to Huntington Lake, a popular recreational area at a 5,900-ft. elevation.

The bridge is a factory fabricated through truss structure designed for an H-15 loading. It has a 20-ft. roadway and required 38,888 ft. of Douglas Fir in its construction. All timbers, except stringers and decking, had been treated with an 8-lb. creosote and petroleum oil treatment and timber connectors were employed in the truss connections.

The contract price for lumber, prefabrication, creosoting, and hardware delivered to the site was $3,201.86, making the cost per linear foot of roadway without erection $35.56.

The Dinky Creek Bridge was designed by the United States Forest Service.

Covered Bridge Replaced

During the unforeseen flood stage of March, 1936, an old covered bridge across the Contoocook River, between Hancock and Greenfield, N. H., was washed away. The original design submitted for the new bridge called for a concrete structure, but the citizens of the community so sentimentally recalled the wood bridge as a faithful servant to their forefathers, that a new covered bridge was designed by the State Highway Department.

The new bridge, which was designed for an H-15 loading and approved by the U. S. Bureau of Public Roads, is built entirely of lumber. Douglas Fir was used throughout, except for the roof, floor, and railing. It

Fig. 3—Hinged Timber Arch Over Dolan Creek on the Carmel-San Simeon Highway, California.

incorporates recent improvements, such as timber connectors, in its construction.

The bridge carries a 20-ft. roadway and has two five-panel 84-ft. main trusses (Fig. 2). Lateral secondary trusses are used for floor beams and bracing of the upper chords. The top lateral trusses were framed into the main truss by means of welded steel knee braces.

The stringers were creosoted and, in addition, every member of the structure within 5 ft. of the bearing rocker seat was creosoted by hand brushing. The sheathing, which consisted of 1x6 spruce lumber, was painted with two coats of brushed creosote. The inside was not painted.

Teco connector rings were used to join the timbers at every major connection throughout the structure. Mr. E. B. Hodgins was resident engineer for the State Highway Department of New Hampshire on this job.

Dolan Creeek Bridge

It is being increasingly realized by builders that timber with modern developments in connection lends itself well to the arch type of construction. An excellent example of this type of bridge is the Dolan Creek Arch, built of redwood by the California Division of Highways and located on State Route 57. This structure, about 50 miles south of Monterey on the 92-mile Carmel-San Simeon Highway, is a three-hinged timber arch and is but one of the 20 wood bridges on this coast highway.

Dolan Creek Bridge (Fig. 3), with an over-all length of 514 ft., has a roadway width of 24 ft. and is made up of a three-hinge arch span of 180 ft. (60-ft. rise), four 38-ft. timber girder spans and nine 19-ft. timber trestle bent approach spans. One end of the structure is on a curve which has been compensated by super-elevation and the roadway has a grade of 0.567 per cent.

An interesting factor in connection with the construction of this bridge is that it was designed to serve under a 40-ton moving load. This is twice the loading normally assumed in California bridge design, but was required because of the frequent movements of 40-ton shovels along this coast route.

Split ring connectors up to 8 in. in diameter were used in assembling the arch ribs and the 38-ft. built-up girders.

The successful bid for the whole 514-ft. Dolan Creek bridge, including excavation, foundations and piers, was $67,871.00, or $132.00 (24-ft. roadway) per linear foot.

The Dolan Creek bridge was designed under the direction of C. H. Purcell, State Highway Engineer of California. The state personnel responsible for the design and construction were: W. Panhorst, Acting Bridge Engineer; H. D. Stover, Designing Engineer, and H. L. McCready, Resident Engineer.

North Umpqua, Oregon, Bridge

Another typical arch of somewhat different lines and shorter span is that bridging the North Umpqua River, in the heart of an important recreational area about 45 miles east of Roseburg, Ore. (Fig. 4).

This 135-ft. arch, which is designed for an H-15 loading, is characterized by simplicity of design and detail and harmonizes with the natural environment.

The arch is 30 ft. in depth at the springing lines and 6 ft. 3 in. at the crown, with a horizontal top chord and parabolic bottom chord. The top chord has a camber of 3 in. The top and bottom chords and vertical members were connected with modern timber connectors.

The top chord consists of two 2-in. x 8-in. side pieces and a 5-in. x 6-in. filler. The bottom chord is made of two 5-in. x 16-in. side pieces, with a 5-in. x 16-in. filler.

Fig. 4—135-Ft. Arch Over North Umpqua River, Near Roseberg, Ore. Located in the Heart of an Important Recretational Area the Bridge Was Designed to Harmonize with the Surrounding Forest

The vertical web members consist of two 4-in. x 14-in. side pieces and one 4-in. x 14-in. filler placed so that the vertical web members, could be fastened to the outside of the chord members. The diagonals are one-piece members which fit into the space between the two pieces forming the chord members.

The deck is composed of laminated 2x4s and is carried by eight 6-in. x 16-in. stringers. These in turn rest on 12-in. x 20-in. floor beams which carry the load into the arch trusses at each panel point.

Due to the erection conditions at the site, all members were fully shop detailed and in addition each truss was shop framed and bolt holes bored while assembled in the shop. After fabrication the Douglas Fir timber was given an 8-lb. empty cell treatment, using a mixture of 50 per cent petroleum and 50 per cent creosote. Materials used in the approaches and arch span were as follows: Creosoted timber, 73,000 bd. ft.; untreated timber, 8,300 bd. ft.; hardware, 7,300 lb.; and cast steel hinges, 600 lb.

for most of the distance. Below this water is a soft alluvial bottom of approximately equal depth. Wave action resulting from the sweep of wind across this wide expanse of open water required a roadway elevation of about 18 ft. above water level. These conditions required treated timber piles ranging in length from 60 to 96 ft. which, when driven, were substantially free standing for a considerable portion of their length. The span between bents is 25 ft. and a longitudinally braced bent is provided for every 200 ft. to resist longitudinal forces. Lateral resistance of these long pile bents against wave action is provided above water level by double systems of lateral timber bracing fastened at both ends to the piles with flat or single curved spike grids. The load capacity of these malleable cast iron spike grids, as indicated by test, is approximately four times that of the usually employed ¾-in. bolt. This increased strength of bracing connections reduces the possibility of side sway and the enlargement of bolt holes under the pounding of the waves.

Fig. 5—View of 3½ Mile Creosoted Timber Pile Trestle Across Albemarle Sound, North Carolina.

William D. Smith, Associate Structural Engineer of the United States Forest Service, was in charge of the design and construction.

Albemarle Sound Trestle

In tidewater regions, bridge engineers frequently encounter a situation that requires a relatively long highway bridge over waters of moderate but not shallow depth, with heavy traffic in shipping lanes. Such were the conditions at Albemarle Sound, North Carolina, in which a 3½-mile timber trestle bridge, with a 330-ft. steel swing span near the middle, was used (Fig. 5).

This trestle, costing approximately $1,500,000, shortens coastal highways from North to South by nearly 15 miles and is part of a cut-off on U. S. Route 15, extending between a point east of Edenton on the north and Pea Ridge on the southern shore.

The steel swing span about 1½ miles from the north shore provides access for shipping to the upper part of Albemarle Sound. The remaining distance is spanned by a creosoted Southern Pine and Douglas Fir timber pile trestle supporting six lines of steel stringers and a reinforced concrete floor.

The depth of water in the Sound is from 20 to 25 ft.

Pile bents are capped with 11-in. x 13-in. timbers to which the upper ends of the 3-in. x 10-in. pile braces are attached with flat spike grids. The lower ends of the braces are connected to the piles by means of spike grids curved to fit the rounded surface of the pile. Connection between the inside pile heads and the caps is made by a special bolt passing through the cap and down along the side of the pile head, where it is flattened to engage the projecting hub of a 3⅛-in. malleable cast iron toothed shear plate timber connector. All bolt holes and connector seats were field treated with creosote before the bolts were installed and the shear plates embedded in their seats.

The Albemarle Sound bridge was designed by the North Carolina State Highway and Public Works Commission under the direction of W. L. Craven, Bridge Engineer, and constructed under the supervision of J. B. Broach, Associate Construction Engineer.

Timber Falsework in Bridges

Timber has always been our principal material for falsework in bridge construction. However, relatively recent developments have extended the use of timber into other fields; for example, long span arch centering for

concrete arches. Timber three-hinged arch centering was used for the Foster, Ohio, highway bridge, the third largest in the state. The arch spans varied from 155 to 175 ft., with a clear rise above springing line of 72 ft. (Fig. 6).

This bridge is a Federal Aid project and involves 6 spans of two-rib open spandrel concrete arches supporting a concrete deck structure having a 24-ft. roadway and a 3-ft. sidewalk. The four central spans bridge the Little Miami River.

The contractor selected an arch type of centering to provide clearances for railroad and highway underpasses and for possible floods in the river.

The use of the timber permitted fabrication on the site by the contractor's regular forces as well as re-use of much of the arch centering material in the falsework for deck structure.

Centering for each span consisted of two three-hinged arch trusses placed together to form the support for one concrete rib. After one rib of the span had been poured, the trusses were shifted sideways into position for the second rib. Ribs are spaced 18½ ft. on centers, each rib being 6 ft. wide and varying in thickness from 4 ft. at the pier lines to about 2½ ft. at the crown. Split ring connectors were used to connect all truss members.

The fact that no two arches have the same span, plus Highway Department specifications on concreting sequence, required construction of falsework arches for five spans. The arches for the first span were altered for use in the sixth span. All arches were designed to permit maximum duplication of layout and joint details. The Douglas Fir timber for the arches was cut to exact length in the lumber dealer's plant, enabling the contractor to handle fabrication with a minimum of equipment.

Carlton, Frankenberger and Barson, Consulting Engineers and Architects, designed the timber arch centering as well as the falsework for the roadway structure. The bridge and approaches were built by the Ohio Department of Highways. The connectors and assistance in fabricating the trusses were supplied by the Timber Engineering Co., of Washington, D. C.

Farm-to-Market Road Bridge

Possibly the bulk of our highway mileage is the often neglected farm-to-market road. These roads, of which it is estimated there are more than 2,000,000 miles in the country, require many structures which must be built at a very low cost. A typical bridge of this economical

Fig. 6—Three-Hinged Arch Made Up of Timber Trusses Framed with Split Ring Connectors Carried Rib Forms of Bridge Across Little Miami River at Foster, O.

Fig. 7—Timber Bridge on Farm-to-Market Road in Butler County, Ala.

type, designed for an H-10 loading with a 12-ft. clear roadway between the Howe trusses, is that located in Butler County at Greenville, Ala. (Fig. 7).

This four-panel wood bridge has a 60-ft. span. The floor joists are 3-in. x 10-in., spaced 18 inches on center, the deck 2-in. x. 6-in. and 2-in. x 8-in. laid flat, and the floor beams are composed of two 6x12's.

This Butler County bridge was designed by E. Talbert, Butler County Engineer.

Trends in Timber Design

In the remote past, improvements in wood construction have depended largely upon the ingenuity of skilled workmen, rather than the application of technical information obtained through research and applied by the designing engineer. This condition is changing rapidly today. Capable progressive engineers, with their superior technical training, are studying the correct use of wood in engineering structures and modern development in wood design.

This healthy trend would seem to indicate that, in the future, as more scientific knowledge of wood is accumulated, and the engineering data on timber become more widely dissseminated, wood will more nearly approach the much wider usage which its inherent merits as a construction material justify.

▼

ANOTHER U. S.-CANADA BRIDGE OPENED—The Blue Water International Bridge, connecting Port Huron, Mich., and Sarnia, Ont., was dedicated on Oct. 7-8. The bridge cost $3,250,000 and was built by the highway departments of Michigan and Ontario with federal assistance and by the State Bridge Commission of Michigan, which erected the main span and coordinated the work of the two governments. The commission, of which V. B. Steinbaugh is chairman, will maintain and operate the bridge.

NOVEL EQUIPMENT AND ECONOMIC ORGANIZATION BY CONTRACTORS

Marks Panhandle Flexible Base Job as Unusual

By H. W. SCHMIDT

Resident Engineer
Texas Highway Department

DOWN in the panhandle of Texas, on U. S. 87 between Dumas and Hartley, a flexible base contract job is nearing completion. An unusual feature of the job is the method of construction of the surface treatment courses and the speed of construction with the contractor's own designed equipment. Ordinarily, to spread 10,000 gal. of asphalt is considered by contractors to be an average day's work. The outfit employed on this job will shoot and cover an average of 25,000 or 30,000 gal. per day on surface treatment work. This phase of the job will be described in its place.

The new work includes widening the existing surface, covering the whole with properly graded, stabilized caliche, priming and sealing with an asphaltic double surface treatment. Production started on the base course material on June 25, 1938, and was completed on July 30, 1938. Note that this is during the hot, dry period in the Panhandle. Preliminary work of stock piling aggregate for the double surface treatment has been accomplished and by the time this is printed the surface treatment will be completed.

Design

Just prior to the Texas Centennial this 10.6 mile strip of road was the only unsurfaced piece on this section of highway. So the state, in order to make an all-weather road for centennial traffic, hauled enough caliche onto the road to make a mat about 4 in. thick. This was sealed with an application of 0.3 gal. of asphalt per square yard to keep the caliche smooth for the centennial. The new design, just nearing completion, took this into account. The all-weather section was only 22 ft. wide. The new base section, as shown by an accompanying chart, is 30 ft. wide, so that widening strips were built along each side. The trench excavation was placed to line by the use of Slade graders and hand shovels. Side forms of wood or steel were not used, which has been customary practice on base construction in this section. The widening strips were trenched and back-filled with selected graded caliche, compacted with a 9-wheel Bros rubber-tired roller, then with a 3-wheel 10-ton roller and smoothed with a grader.

The old cake was not even scarified and along with the widening formed a sub-base for an additional 6-in. (compacted) of suitably stabilized caliche material, making a total base thickness of 10 in. As will be noted by the chart, the center 22 ft. of the 30-ft. cross section bears a 2-in. parabolic crown. The remaining 4 ft. on each side slopes at the rate of ¾ in. per ft. The purpose of the rapid side slopes is to quickly remove surface water.

Only 26 ft. of the 30-ft. top was primed 13 ft. each

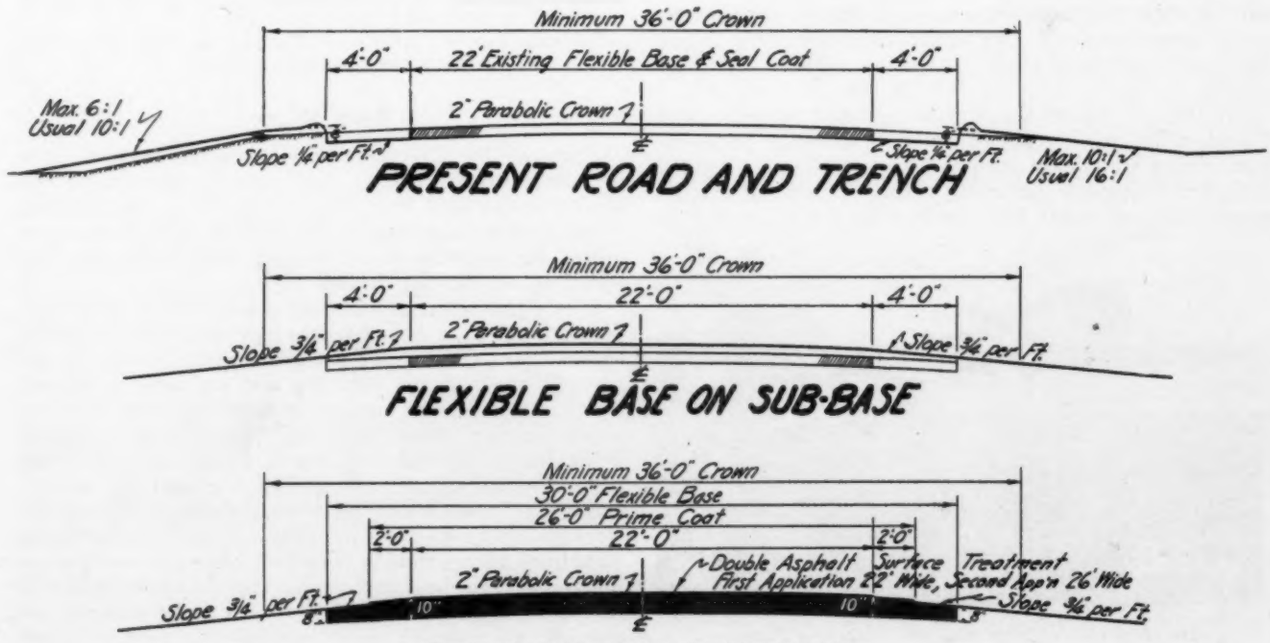


Fig. 1. Cross Sections of Flexible Base Job.

Excavating Caliche in McDade Pit.

side of center line. This leaves 2 ft. on each side open. Of the 26 ft., only 22 ft. will receive the first surface treatment application with No. 1 aggregate. The second surface treatment application will cover the first and extend 2 ft. each side for a total width of 26 ft., the same as the primed width. No. 2 aggregate will be used for the second application.

Five concrete crossovers were built into the 10.6 miles at as many cross roads. The caliche base at these points was removed to a depth of 7 in. for a length of 15 ft. The concrete poured into these crossovers was reinforced to protect the road against farm machinery crossing it. The asphalt surface treatments will be spread right on over these concrete crossovers.

Structures on the road were all built under a "Works Progress" arrangement and were all completed when this job started. There are no special drainage problems—the country is quite flat.

About 3 miles from the line of the job we located a deposit of properly graded, stabilized caliche having suitable test constants. The average haul on the material for the whole job was 5½ miles.

Construction

A tractor and pull grader widened the old surface to the 30-ft. stake lines on each side, right to the subgrade line. At first a scarifier was tried. It was soon discarded when the discovery was made that it dug the subgrade loose too deep. An accompanying picture shows the trench widening ready to receive suitably stabilized caliche.

At the pit where the suitably graded material was found, a 2½-yd. Northwest shovel loaded the pit excavation into trail body bottom dump trucks that hauled it to a crushing and screening plant. This plant was an arrangement of parts put together by the contractor as necessary to produce a material that would meet the specifications at the rate of 2,000 cu. yd. per day.

General View of Crushing and Screening Plant.

Screening Plant

The trucks dumped the pit-run material over a rail bar grizzly having an 8-in. opening between rails. From the hopper of the grizzly the material was dropped into a 21-in. x 36-in. McLanahan single-roll crusher that broke up the lumps. The crusher was driven by a Caterpillar 65 tractor with belt pulley attachment.

From this crusher the material was carried by belt conveyor onto a 4-in. square opening 4-ft. x 10-ft. double deck Pioneer shaker screen. The oversize from this screen was dropped into an 18-in. by 36-in. single-roll McLanahan crusher, from which it rejoined the original material passing the 4-in. screen. A Caterpillar 9500-G gasoline engine drove this second roll and conveyor set. Up the next belt conveyor the material traveled onto a 2-in. vibrating 4-ft. x 12-ft. Plato screen. The oversize from this screen was passed through a Pioneer Super-40 double roll crusher and was then conveyed back onto the belt running to the 2-in. screen. A Twin City 165hp power unit drove the third roll and conveyor set. All material passing the 2-in. screen was dropped in a bin for storage and removal by trucks.

The whole screening plant arrangement was built up by the contractor, piece by piece, to produce the desired maximum sized material. Field laboratory tests showed that the pit material was suitably graded for stabilized flexible base construction.

Subgrade Trench. Caliche for Widening Is Dumped on Old Surface and Bladed Into Trench.

Base Work

Some of the 25 trucks were required to haul from the shovel to the grizzly, but most of them were employed in the haul from the storage bin to the job site. A patented arrangement on the bottom dump leaves permitted the material to be dumped quite uniformly in a windrow on the old surface cake.

All of the base material was placed before water was distributed by the 5 tank trucks equipped with sprinkling bars. 79.6 gal. of water per cubic yard of material was actually used. Some difficulty was encountered in wetting the caliche due to varying depths of the loose material which resulted from the unevenness of the old pavement. The shallower places would become too wet when the deeper places were of the correct moisture content. Traffic was allowed over the road during construction and sometimes the tires cut deep ruts in the too wet cliche during rains. However, since the weather was hot and dry, the base rapidly gave up the excess water. In cases where the water did not soak into the material fast enough, an ordinary farm harrow was used to loosen

the top crust. After the water had soaked in, the loose material was first rolled with a rubber-tired 9-wheel Bros roller to refusal. The finished surface was secured by blading, sprinkling and rolling with a 10-ton 3-wheel roller. These operations were repeated until the base was of the desired cross section, thoroughly set up and smooth to receive the prime coat. There was no me-

Blading Caliche Into Trench.

chanical means of mixing the water with the caliche base material. Rolling was done longitudinally, progressing from the edges to the center.

Every 500 cu. yd. of the material was sampled and

Rolling Widening Course with Pneumatic Roller.

Unloading Surfacing Gravel With Special Unloading Outfit.

tested to control uniformity. Following is a table of specifications and actual material test constants:

Test Constant	Specification Material Passing 40-Mesh Sieve	Material After Going Through Plant
Liquid Limit	Shall not exceed 45	26-33
Plasticity Index	Shall not exceed 15	5-9
Linear Shrinkage	Shall not exceed 8.5 per cent	3-5 per cent

All 40-mesh material was properly slaked when tested. Of the whole material, 100 per cent passed a 2-in. screen and that retained on the 40-mesh sieve was kept within the specification limits of 50 to 85 per cent.

Surfacing

The double asphalt surface treatment was sublet to a contractor who specializes in surface treatments. He organized the job in such manner that equipment of his own design and manufacture can be used.

Aggregate for the surface coats was furnished by the Texas Sand & Gravel Company and delivered by rail from Ady, Texas. At the siding the contractor unloaded the aggregate with a truck mounted scraper rig which pulls two slip scrapers in the car. A double drum hoist with double load fixed boom on the side of the truck pulls the scrapers in the car up to a chute mounted on the side of the flat-bottom railroad coal car. The gravel spills down the chute into side dump trailer trucks. The

Loading Trucks from Stock Piles With Special Loading Unit Built by Contractor.

men on the slips in the car drag them back for another pull. The contractor finds this method faster and more economical than crane and bucket unloading. The gravel was hauled to the road and stock-piled in windrows on each side of the roadbed. Each windrow of No. 1 and No. 2 aggregate contained 16 and 8 cubic yards spaced at 1,310 and 1,108 foot intervals, respectively.

Another outfit designed and built by the contractor picks up the stockpiled material and drops it into dump trucks on which spreaders are mounted. However, this second outfit does not start until all of the gravel for the entire job has been stockpiled. The reasoning for this procedure is sound. Once the spreading starts a uniform haul distance and a constant amount of equipment is maintained. No delays for material are experienced, except for breakdowns. This contractor averages 500,000 gallons of asphalt in surface treatment work per month with his outfit.

The outfit on the road is all mounted on a truck and trailer chassis. The two single drum hoists on the truck pulls as many slip scrapers. One scraper is on each side of the road working in the stockpiled aggregate. A man holds each slip which is pulled through each stockpile to the boots of short belt conveyors. The short conveyors on each side raise the material up to a long belt that runs longitudinally up the center of the chassis. This central belt spills the material on two more short belts which carry the material sideways into the spreader mounted dump trucks. A big suction fan removes all dust and light foreign material from the gravel as it spills from the central belt to the short belts leading to the trucks.

There is a truck on one side or the other of this outfit at all times. These trucks pull forward over the completed work and back down the road to spread; hence, the loading outfit always works on finished roadway. So, in starting, it begins loading off of the job at one end.

Two sizes of gravel are used. For the first application, after a priming coat of 0.3 gal. M-C-1 cut back asphalt per square yard has been applied and set, an oil asphalt designated OA 135 is spread at the rate of 0.2 gal. per square yard for a width of 22 ft. This is done by one tank with a 22-ft. spray bar. The No. 1 gravel spread at the rate of 1 cu. yd. per 100 sq. yd. on this first application is sized as follows:

	Per Cent
Retained on ⅝-in. sieve	0
Retained on ½-in. sieve	0-10
Retained on ¼-in. sieve	70-100
Retained on No. 10 sieve	95-100

This is spread by trucks backing at the rate of 1 cu. yd. per 100 sq. yd. The 5-ton 3-wheel roller sets this gravel after it is uniformly and evenly spread with 8 ft. patrol graders and drag brooms pulled by trucks, hand brooms and rakes.

The No. 2 aggregate meets the following specifications:

	Per Cent
Retained on ⅜-in. sieve	0
Retained on ¼-in. sieve	2-20
Retained on No. 10 sieve	70-100
Retained on No. 20 sieve	95-100

The oil asphalt, Texas Specification OA 135, meets the following specification:

Limits	Min.	Max.
Penetration, 77 deg. F., 100 gr., 5 sec	120	150
Ductility, 77 deg. F., cm	100	...
Flashpoint, deg. F	450	...
Melting point, deg. F	104	140
Loss, 325 deg. F., 5 hr., per cent	...	0.75
Penetration of residue at 77 deg. F	70	...
Sol. CCl_4, per cent	99.5	...

The material shall not be cracked.

The pneumatic tired roller is used to finish the second application, which is spread 26 ft. In other words, the second application is 4 ft. wider than the first, and the same width as the prime coat.

At the beginning and ending of each run, the distributor crosses several strips of Kraft paper spread across the roadway. The valves are opened and closed at required speed over these sheets, thus insuring uniform connections. Particular care is taken with nozzles to see that all flow freely and uniformly, thus eliminating the ridging so often noticed on surface treatment or seal coat

Another View of Special Loading Unit Loading Trucks from ***Stock Piles.***

work. The second application of OA 135 is at the rate of 0.3 gal. per square yard, covered by No. 2 gravel at the rate of 1 cu. yd. to 200 sq. yd.

Quantities and Bid Prices

The final estimated cost, including engineering, on the 10.6 miles is $67,700. Involved are the following quantities:

Item	Quantity	Bid Price
Stripping pit	6,233 cu. yd.	$ .08 per c.y.
Springling	4,064,000 gal.	1.00 per M
Rolling (3 wheel)	595 hrs.	2.50 per hr.
Rolling (Pneu.)	428.5 hrs.	2.50 per hr.
*Base material (Caliche)	51,131 cu. yd.	.43 per cu. yd.
Additional ¼ mile-haul-yd.	1,062,987	.0125 per ¼ mi.—c.y.
Prime coat	48,455 gal.	.08 per gal.
Asphalt OA 135	76,530 gal.	.075 per gal.
Aggregate No. 1 and No. 2.	2,183 cu. yd.	4.50 per c.y.
Class A concrete	48.60 cu. yd.	18.00 per c.y.
Reinforcing steel	2,585 lb.	.065 per lb.
Blading embankment	60 hrs.	3.50 per hr.

*In place except overhauling, stripping, sprinkling and rolling. In the bid price of base material, the contractor is required to include ¼ mi. free haul.

Equipment

To do the job the contractor has the following equipment:

1—Adams tandem-drive motorgrader
1—Northwest 2½-yd. shovel
2—Super-mogul Russell graders
1—Caterpillar 66 pullgrader, 12 ft.
3—Caterpillar gasoline tractors
5—Water tank trucks equipped with sprinkling bars
25—6 cu. yd. trailer type bottom dump wagons with controlled opening, Carlisle and Herbert
25—Light trucks: Fords, Chevrolets, and Internationals
1—Caterpillar 12-ft. motorgrader
1—Assembled screening plant: Barber-Greene, Diamond, McLanahan, Pioneer, Twin City, Caterpillar
1—Special Jagoe car unloader
1—Special Jagoe truck loader
1—Etnyre distributor
3—Shuttle tanks
2—Wm. Bros pneumatic tired 9-wheel rollers
1—Converted 3-wheel 10-ton roller
Necessary small tools

Those Responsible—The work is being done by Field Bros., Lubbock, Texas, contractors, who sublet the surface treatment work to the Public Construction Company, Denton, Texas, W. M. Jagoe, Pres.

The project was initiated and planned by the then Division Engineer, W. J. Van Lunden. Resident Engineer H. W. Schmidt supervised construction and engineering for the highway department. W. L. Turner was superintendent of construction for Field Bros.

Spreading Surfacing Gravel.

Distributing Surface Treatment Asphalt.

ASPHALT MEETING DATE IS CHANGED FROM FEB. 20TH TO 27TH

Announcement has been made that the 12th National Asphalt Conference will be held in Los Angeles during the week of Feb. 27, 1939, instead of the week of Feb. 20 as previously announced.

The meeting, which will be under the auspices of the Asphalt Institute will be presided over by Joseph W. Helm, president of the Asphalt Institute and manager of the asphalt department of the Standard Oil Company of New Jersey. J. E. Pennybacker, managing director of the Institute, will serve as General Chairman, with Daniel Miller, of the Institute's West Coast branch, acting as Co-Chairman.

The Conference theme will be "20 Years of Progress." Agenda, exhibits, and speakers including highway officials, engineers and industry members will point up the fact that 1939 marks the 20th anniversary of Federal Aid for Highways. The Federal Aid law was actually passed in 1916, but because of the World War, it did not become effective until 1919.

Mr. Pennybacker, in announcing that the meetings would serve as a clearing house for the most efficient road building methods of the past 20 years, stated that this summation of engineering achievement was intended to serve as a foundation upon which even greater progress during the next 20 years could be built.

The Conference will stress the importance of balanced highway programs and special studies will also include soil stabilization, flood control, harbor protection, airport surfacing and highway sidewalks. Officials from the U. S. Bureau of Public Roads are expected to contribute to the discussions, in addition to engineers from the U. S. Army Engineering Corps.

FOUR STATES TO VOTE ON DIVERSION BAN.—Alabama, California, Michigan and New Hampshire will vote at the 1938 Fall elections on Constitutional Amendments prohibiting the use of special motor vehicle taxes for other than highway purposes.

SHORT TIME TRAFFIC COUNTS

By GEORGE HARTLEY

Engineer, Robinson & Steinman, Engineers, New York

Traffic Analysis: The interpretation of highway traffic behavior, its composition, calculation and growth has become a subject of vital interest to the citizens of every modern growing community. The very life of their community may be dependent upon adequate provision for the modernization of existing highways and the proper planning of proposed future construction. Basic data required in order to evaluate any planning project will be dependent to a large extent upon the particular function of the survey its scope and intention but in any survey involving motor vehicles some record of existing traffic volume and composition must be obtained. This record of existing traffic is obtained by means of a traffic count and the extent and scope of this count will usually be dependent upon the funds available for the survey. As these funds are in almost all instances extremely limited, long time continuous counts cannot be made and a short time count becomes imperative. This article will define some of the elementary concepts of the short time traffic count and their relationship to full time counts and actual traffic.

Although rapid advancement has been steadily made in the field of traffic research the full understanding of highway traffic behavior is still in its infancy. Many of the problems which have perplexed students of "Traffic Engineering" have been solved or suitable expedients substituted, but the extent of this new field of applied engineering is so great, its possibilities so unfathomable, that the challenge thus offered to the research student cannot be ignored.

As already stated, any survey involving the consideration of motor vehicle traffic requires as an important feature the establishment of traffic count stations at which points actual observation counts of motor vehicles are made. When a continuous count is undertaken the traffic for any given period of time will, of course, be equal to the summation of the traffic counts for the duration of the period. As continuous counts are seldom possible due to the extremely high expenditure required for personnel and equipment, or due to lack of sufficient time in which to prepare a continuous count the short time count then provides the only logical basis for its presentation as for instance, when the traffic engineer must submit a recommendation or objection to some specific factor, for example, a proposed toll bridge which through publicity has reached its culmination. These short time counts are limited in their scope and application, but, with an intelligent use of the survey data usable approximations of the continuous traffic flow may be estimated. This approximation of the continuous traffic flow is then used and applied in any study requiring a continuous traffic count and the results thus obtained will represent the best approximation of total traffic which may be derived from the short time count.

The use of short time traffic counts finds its greatest application when the survey of a large area is undertaken and the traffic at many stations throughout the area desired. As many control stations are established as possible at which full time continuous counts are made; for other locations short time count stations provide the means of obtaining the relative traffic at these stations.

When control stations are established they are so located as to represent as closely as possible an average conditon for the short time traffic counts in its vicinity. Under some conditions it may not even be possible to establish a control station and statistical summaries of previous years may be substituted for the control station count. Essentially the main function of the short time count is to secure an index which may be correlated to the control station count thereby providing an estimate of the full time traffic at the short time count station.

Traffic characteristics, composition, origin and destination studies, etc., will be based: first, on the recorded data at the short time count station; and secondly, supplemented by the same data as recorded at the control station. The conclusions thus obtained will represent only approximations of the probable traffic and the degree of correlation with actual traffic will be directly proportional to the amount of time alloted to the field survey stations as will be shown later. Therefore, any survey which does not represent a continuous period count, and all short time counts fall under this classification, should be critically analyzed in order to reduce observation errors to a minimum.

Now consider that a one hour count at one of the short time traffic stations in the area of this count represents the only available data as to traffic and that the yearly traffic at the station is desired. Under the condition thus established the best estimate of daily traffic is given by the expression:

$$(Td) = [(hc)\ (Cd)] \div (Ch) \quad (1)$$

where:

Td = the daily traffic at the one hour traffic count station

hc = the one hour traffic count (volume)

Cd = the control station daily traffic on day one hour traffic count was made

Ch = the control station one hour count for the same period as the count at the short time count station

and similarly: the best estimate of weekly, monthly and yearly traffic based on a one hour count at the short time count station will be given by the following expressions:

$$(Tw) = [(hc)\ (Cw)] \div (Ch) \quad (2)$$

$$(Tm) = [(hc)\ (Cm)] \div (Ch) \quad (3)$$

$$(Ty) = [(hc)\ (Cy)] \div (Ch) \quad (4)$$

and, for the count at the control station it is apparent at once that:

$$(Ty) = (Cy) \quad (5)$$

$$(hc) = (Ch) \quad (6)$$

When the counts at the short time count station tend to become continuous, it will be found that by similar reasoning expressions may be derived for any period as follows:

$$(Td) = [(hc)\ (Cd)] \div (Ch) \quad (7)$$

$$(Tw) = [(Td)\ (Cw)] \div (Cd \quad (8)$$

$$(Tm) = [(Tw)\ (Cm)] \div (Cw) \quad (9)$$

$$(Ty) = [(Tm)\ (Cy)] \div (Cm) \quad (10)$$

then expressing Ty as a function of Td and substituting throughout for Tm, Tw and Td we obtain:

$$Ty = \frac{[(Cy)\ (Cm)\ (Cw)\ (Cd)\ (hc)]}{[(Cm)\ (Cw)\ (Cd)\ (Ch)]} \quad (11)$$

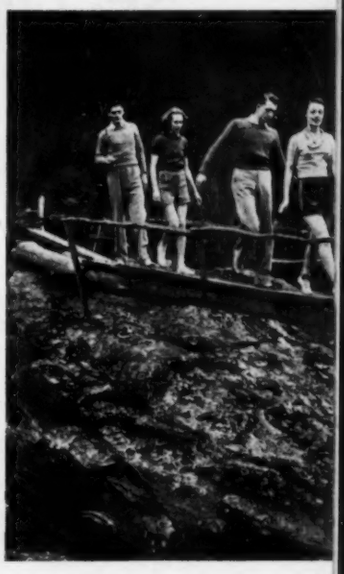
combining:

$$Ty = [(hc)\ (Cy)] \div (Ch) \quad (12)$$

which equals equation (4) and represents the best estimate of annual traffic which may be derived by means of a one hour count of traffic.

Above: The new Albemarle Sound Bridge. Stretching 4.45 miles across the waters of the sound, this structure was opened to traffic on August 25. It connects highways 17 and 64, and saves a 40-mile drive around. There is a draw span at the main channel.

It's a far cry from this century-old footlog in Avery County to the 4½-mile viaduct across Albemarle Sound, but hundreds of such "bridges" facilitate travel in the Blue Ridge section of the state. The young moderns seem to like it.

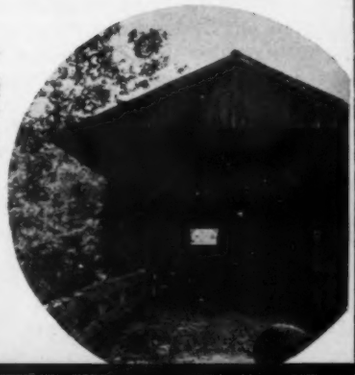


THE OLD, THE NEW AND THE ODD
IN NORTH CAROLINA

Photos by Courtesy Department of Conservation and Development State of North Carolina Bill Sharpe, News Bureau Manager.

At Left: One of North Carolina's Famous "Floating Highways." This structure in Washington County carries traffic efficiently over the swamp muck on which it rests.

Below: A "Bridge" Over an Ocean of Sand. Upon Hatteras, ingenious construction to defeat the soft sand has been devised. These wooden ruts help the motorist to climb small dunes. Nearby sand has been fixed by plantings of tough beach grass.



Beloved by spooners and small boys, these old covered bridges remain on many out-of-the-way country roads in No. Car.

SELLING THE HIGHWAY STORY TO THE PUBLIC

IN this wide gulf between highly technical highway departments and the man on the street comes a new type of critter—at least to engineers. Sometimes he is known simply—though critically in some quarters—as a publicity man. He may reappear at other times with the more impressive title of public relations counsel. Then again a counsel on public information may be hobnobbing with engineers in some highway departments.

Whatever his title, it is this man and his associates to whom highway administrators of the country must look to get their story over to the average man. And it is this same man who must sell highways and the highway industry to the American public.

It was probably the first of these two functions that prompted some pioneering highway official to go out and hire a newspaperman for the first time. This same official was probably surprised one day at his office when he was confronted with a delegation of the entire corps of capital correspondence in his state. They wanted to know all about what happened to the millions of dollars collected from motor vehicle owners in the last year and they wanted it in detail to the last penny. This seemed like an affront—a dart at his personal honesty—to this highway official whose official integrity had never been questioned. And he told the newspapermen as much. The next day, he was surprised, in reading his morning paper, to learn that "Highway Chief Hits Public—Says Road Tax Information Nobody's Business."

While all this may be an exaggerated account of that press conference, it illustrates the need for an "Open door" policy in highway affairs.

What is true in the newspaper field is no less true in other mediums of giving out public information. Comparatively few state highway departments are making use of the radio, motion pictures and exhibits. Trained men are necessary if these activities are to be carried on effectively. It is not work for engineers.

Most of the 30,000,000 American motorists today are paying highway taxes without the slightest idea of where their money goes. Millions of American citizens have no conception of the difference between contract and force account work. Many motorists still cling to the theory that the public safety problem can be solved by conversation and stickers with wise-cracking slogans. How many citizens know about the bidding procedure arranged for their protection? How many, finally know anything about a highway except the one that goes by their door or through their town?

In rebuttal comes the argument, "What's the matter with keeping our 'doors open' but giving it to the newspapermen direct?" The best answer is that most engineers know less about newspapers than newspapermen know about engineers. Another answer is that newspapermen, in their coverage, can do just so much. In one state capital, they cover more than sixty state departments spread over more than a dozen buildings. A third and perhaps the most important answer is that many people are not reached through the medium of their daily newspapers. Hence the provision for weekly newspapers, radio, exhibits, motion pictures, highway speakers at public meetings and so on.

The second function springs from the first. And this function of salesmanship appears to be the most important in view of present-day developments.

Years ago all we needed in our highway departments were technicians to build roads, maintain them, and keep within the financial requirements of our budgets. Property taxes pretty well met the general needs of government. Motorists were glad to pay special taxes for the privilege of driving their automobiles over the highways. The thought of using these revenues for general governmental purposes had occurred only to a few and in negligible amount.

But the depression brought a change. The property tax suffered a national break-down. The cost of government mounted. Governmental experts sought the easiest way out and turned to highway revenues. Today diversion has grown to nearly $200,000,000 a year.

A strange thought began to be circulated about the land. Our highway system is either all-adequate or overbuilt, it said. This theory has even spread to Washington and we witness the spectacle of Federal Aid, the very lifeblood of the American highway system, being threatened from year to year.

Highway Planning Surveys in 46 of the 48 states are in progress. Highway administrators are shortly to be given the tools for the most scientific development of our highway system they have ever possessed. But what good is this information if revenues are not available to use it?

There will be a wealth of material from these surveys which will be of immeasurable benefit almost exclusively to highway engineers. The fact remains, however, that the results will, in all probability, suggest certain action in which the support of the public must be solicited. In short, the surveys must be sold.

Even now two-thirds of our rural highway mileage remains unimproved. Much of the primary trunkline mileage in every state is still incomplete. The country is notably weak in the development of multi-lane and divided highways. Forty thousand people were killed on the highways last year.

Aside from these needs, the public should be shown its further stake in the highway system. It needs to be shown how much the highway industry is contributing to our national economy and to national employment.

The situation is not altogether a discouraging one. In the few states which have a constitutional prohibition against diversion, the value of an intelligent information campaign has proved itself. The same is true of other specialized campaigns; for example, in Michigan where selfish efforts to wreck the financial structure behind that state's highway system by changing the constitution were defeated.

Michigan is now one of seven states in which anti-diversion amendments to the Constitution are pending. Here is another field of endeavor, of vital importance to all highway officials, in which the services of competent public relations men are needed.

In fact, Michigan is showing the way to other states in the use being made of such services. The public relations division is on the same footing in the state highway department as construction, research, maintenance, bridge, and other divisions. The public relations division is on its toes in every field—newspapers, radio, motion pictures and exhibits.

What Michigan and few other states are doing every state highway authority can do. It must be done if the highway story is to be put across to John Q. Public.

A powerful International TD-40 Diesel TracTrac-Tor opening a road in northern Maine. Drifts like this are a real test of equipment. Bank on International to lick them.

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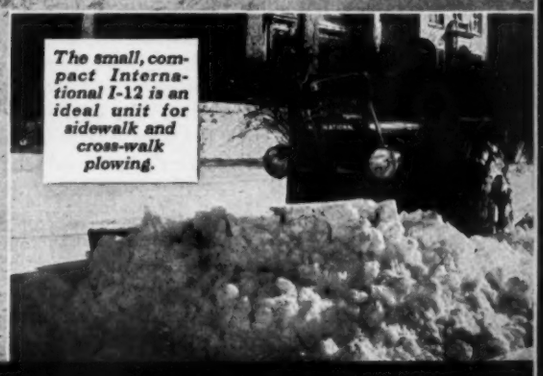

The small, compact International I-12 is an ideal unit for sidewalk and cross-walk plowing.

INTERNATIONAL HARVESTER

SOME REMARKABLE EFFECTS OF SOLAR AND STELLAR ELECTRON EMISSION

By HALBERT P. GILLETTE
330 South Wells St., Chicago, Ill.

ALTHOUGH it had long been inferred that the sun emits electrons, it had been supposed that it emits also an equal number of protons. About five years ago I advanced the theory that the emitted solar electrons exceed the protons in number, and that this excess occurs because great gravitative pressure converts more protons than electrons into radiant energy. At the same time this pressure theory explains the cause of the radiant energy of the stars and its quantitative relation to their masses.

I was led to advance the theory of preponderant electron emission because there seemed to be no other way of explaining certain phenomena, notably the negative surface charge of the sun, the magnetism of the sunspots and of the sun as a whole. Moreover, the same theory explains terrestrial magnetism, which has always been very puzzling.

If the earth's core constantly emits a preponderance of electrons (and its negative surface charge indicates that it does), then there must be cyclonic whirls in that core, according to the Faraday principle of magnetic rotation of electric currents. But if an equal number of protons were emitted, no molten-cyclones could occur, for the positive protons would neutralize the rotative effects of the negative electrons. Numerous circular arcs of uplift, both in the earth's crust and in that of the moon, bear witness to former molten-cyclones of great intensity and magnitude. Incidentally I have found that on the earth the diameters of these circular arcs are too nearly commensurable with the diameter of the earth to be accidental. There is a double-progression series of crystal-arc diameters whose ratios to the earth's diameter are approximately ½, ¼, ⅛, 1/16, 1/32, 1/64, 1/128, 1/256, 1/512, etc. There is also a series intermediate between these diameters. Similar series exist on the moon.

The diameters of planets as well as the mean distances from the sun show a similar double-progression series, with intermediate series. The same holds true of their satellites. The latter fact is beautifully brought out as to the four largest planets (Jupiter, Saturn, Uranus and Neptune) if we assume that each has a molten core whose diameter is ⅔ that of its visible disk. Such a core diameter also shows that the densities of their cores are approximately that of the Earth (which is 5.52) with the exception of Saturn's core which is 2.43, or about that of rock. This exceedingly low density of Saturn's core probably is related to Saturn's unique system of rings composed of minute asteroids. Faraday suggested that if its rings are composed of diamagnetic matter they would lie exactly in Saturn's magnetic equator. The low specific gravity of Saturn indicates that the rings are diamagnetic.

Since the sun's apparent density (1.41) is almost the same as that of Jupiter's visible sphere (1.34), I infer that the sun also has a molten core whose diameter is ⅔ that of its visible shell.

The 10 largest planets have mean solar distances that are too nearly commensurable with this inferred diameter of the sun's core to be accidental. For example, Mercury's mean distance differs from 128 times the diameter of the sun's core by only 2.5 per cent.

One of the most surprising of all such facts is that the diameters of comets' luminous heads are too nearly commensurable with the diameter of the sun's core and with the diameters of the planets to be accidental. Comets' heads change in size, and I find that they change systematically. Thus Halley's comet, at its last appearance, had heads several of whose diameters approximated terms of a double-progression series, namely about 14,000, 30,000, 120,000, and 220,000 miles. It also had at one time a "faint outer nebulosity surrounding the head" whose diameter was about 550,000 miles. Since the diameter of the inferred sun's core ($\frac{2}{3} \times 864{,}000 = 576{,}000$) differs less than 5 per cent from 550,000, it follows that so small a difference is probably not accidental. When the head of this comet was 30,000 miles in diameter it differed less than 8 per cent from the diameter of the disc of Uranus, and less than 4 per cent from that of Neptune.

Other comets' heads show equally surprising relationships. From such facts I have been led to infer that a comet's head and tail are not composed of material ejected by the comet, but are composed of material ejected by the sun. According to the theory above outlined, the sun ejects electrons. Since they are magnets when in motion, they carry magnetic molecules with them; and since they also induce charges in neutral molecules, the latter also are carried away from the sun by high-speed electrons. When such an electronic stream approaches a large group of meteorites that are largely composed of iron, the iron becomes magnetized and then acts as the core of an electron-shell or electronosphere, which, if luminous, is the head of a comet.

The head of Donati's comet in 1858 had "several concentric sheets of light." One drawing shows two concentric hemispherical luminous shells, the outer one having twice the diameter of the inner shell. All comet tails stream away from the sun, indicating electric repulsion of the electrons in the tail by those in the sun and its encasing electronospheres, notably the incandescent photosphere and the spherical corona, whose diameters also are as one is to two.

The orbital periods of the 10 largest planets show too many approximations to harmony to be accidental. The same is true of those double stars whose orbits have been accurately determined. What is more, their mean distances apart are too often so closely commensurable with

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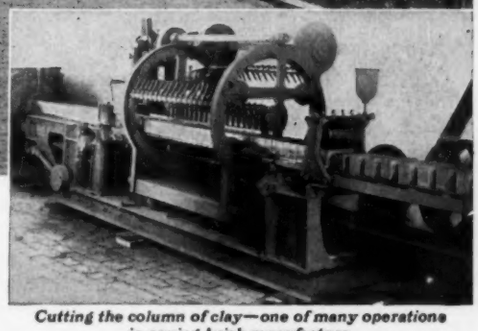

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BRICK

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planet mean distances from the sun as not to be accidental.

It has long been known that many a comet has its aphelion (or position farthest from the sun) near the orbit of some great planet, e.g., Jupiter; and it has been incorrectly inferred that the planet had captured the comet. I find that the perihelion (or position nearest the sun) at times is either near the mean orbit of a planet, or else near a commensurable circle. The perihelion of Pluto (the most remote planet) lies too near the orbit of Neptune to be accidental. From such facts I infer that orbital bodies that have both perihelia and aphelia in solar electronospheres tend to grow to greater size than other orbital bodies, the greatest sizes usually occurring where the orbit is nearly circular, so that the planet is always in the same solar electronosphere.

The magnetism induced in a comet's nucleus evidently attracts solar electrons, and they probably leave behind some of the iron, aluminum and other atoms that they have carried away from the sun. Hence comets tend to grow in mass. In like manner, the satellites of planets probably grow, their growth being much more from solar than from platetary ejecta.

The moon's face nearest the sun is most heavily charged with solar electrons. Since they reflect light and form cyclonic cylinders the moon is four times as brilliant per unit of area at full moon than at half moon.

Iapetus, which is one of the moons of Saturn, is five times as bright at its western as at its eastern elongation. Hence its rear face is amazingly more brilliant. This is explainable if Iapetus is moving rapidly through a dense electronosphere, for electric repulsion would increase its own electron charge on its rear face, thus making that face a better reflector of sunlight.

Since the sun's motion through space has a northern component, its southern hemisphere should usually have a greater charge of electrons, and therefore should have more sunspots. This is usually the case. At one time for 32 years no spots were visible in its northern hemisphere. Auroras are more frequent and more brilliant in our northern than in our southern hemispheres. The same is the case as to molten cyclones, as is shown by the predominance of land in the northern as compared with the southern hemisphere. The cause probably is spiraling electrons from the sun's southern hemisphere whose magnetic polarity is opposite to that of the earth's north magnetic pole, thus attracting them to our northern hemisphere.

Sunspots tend to occur more frequently on the face of the sun farthest from a large planet. I infer that the mutual electric repulsion between the sun and the planet (including their emitted streams of electrons) increases the electrons on the sun's far face, thus favoring the development of sunspots there.

There are many other inferences from this electron emission theory that are similarly confirmed by facts.

Iron ordinarily loses its magnetic properties when heated to redness, but Faraday made an experiment (Electrical Researches, Vol. III, p. 54 and 81) that led him to say: "The deep magnetic contents of the earth, therefore, though they probably do not constitute of themselves a central magnet, are just in the condition to act as a very weak iron core to the currents around them, or other inducing actions, and very likely are highly important in this respect." The experiment that led to this inference involved the magnetization of an incandescent strip of iron by an electromagnet, although it could not be magnetized by a permanent magnet. He did not know that electrons exist and that under such a condition they would leak across the air to the iron that was positively charged as a result of heating. Evidently this electric current made the hot iron magnetizable. Probably this Faraday experiment, thus interpreted, would have led sooner to an understanding of the cause of terrestrial magnetism had it been known also that the earth's core constantly emits electrons in excess of protons.

Incidently this theory of preponderant electron emission shows how molten-cyclones can be generated in the earth's core, for electrons escaping in a magnetic field tend to rotate around lines of magnetic force; and, rotating thus, magnetize the molten iron, thus creating a local electromagnet. Permanent molten-cyclones probably account for the fact that the earth's magnetic axis is not identical with its geographical axis of rotation.

I infer that cyclic changes in the magnetization of the earth's core by solar electrons causes changes in oblateness of that core, hence in sea levels, and in the rate of axial rotation. I have found a rainfall and earthquake cycle of exactly 189 years that corresponds closely with a cycle of variation in the length of the day. I have found a climatic cycle of $3 \times 189 = 567$ years that is likewise correlated with the sea-level cycle that Pearson discovered nearly 40 years ago.

Hale discovered that sunspots occur in pairs that rotate in opposite directions and have opposite magnetic polarity. Hence in spite of the great temperature free solar electrons are able to produce magnetic fields. The great strength of these local fields, which far exceeds that of the sun as a whole, seems to me explainable only if the spirally ascending and descending electrons induce magnetism in the core about which they circulate.

In like manner I believe that terrestrial electrons moving spirally, magnetize the oxygen (the most magnetic of gases), and so cause both cyclonic and anticyclonic whirls in the atmosphere. In causing these whirls, the solar electrons that enter the atmosphere probably play a bigger part than is played by the terrestrial electrons.

The axial rotation of planets can be accounted for as a result of the emission of electrons from their core toward their poles. The angular momentum of their orbital motion may be similarly due to the magnetic rotation of the electronospheres that encase the sun.

But how is the retrograde orbital motion of 8 of the 26 satellites of the planets to be explained? One of the planets, Uranus, spins axially in a retrograde direction, and its 4 satellites revolve orbitally in the direction of that spin. I infer that the axis of Uranus has revolved through 98 degrees since Uranus was generated. What could cause that? Gyration of the sun's axis. The streams of electrons shot spirally from the cyclonic sunspots must act magnetically upon every planet, very much as a current of electrons through a wire acts upon a nearby compass needle. Let the sun's axis gyrate and there must be periodic changes in the inclinations of all the axes of the planets; and those farthest from the sun must tend to be most affected.

It seems likely that terrestrial climates may have been greatly affected by such periodic changes in the inclination of the earth's axis. Astronomers have thought that great changes in the inclination of a planet's axis are impossible; but they have considered only gravitation and inertia as the controlling forces. Let there be a preponderant emission of electrons from large masses, and there results a celestial system differing in many important respects from any hitherto conceived. In such an electronic-emission system, motions may possess a harmony, and distances and dimensions a commensurability not found in a system that is purely gravitative.

If electrons constantly escape from the earth, they should produce electrolytic effects in the ocean. This

(*Continued on page 67*)

inference is confirmed by the fact that while river water salts average about 80 per cent carbonates and 7 per cent chlorides, sea water salts average only 0.2 per cen carbonates and 89 per cent chlorides. This remarkable difference has long been a great puzzle; but is about what should exist if the earth is discharging more electrons than protons; for this electric current would liberate the chlorine at the bottom of the ocean, which would convert the carbonates into chlorides.

It has been suggested more than once that electrolysis might account for certain ore deposits, but since there was no apparent source of adequate currents of electricity, that theory has never had many advocates. Now, however, the electrolytic theory should gain ascendency. It does not require a flow of water through crevices or porous rock, for diffusion of metal ions and currents of escaping electrons would cause deposition of metals at the surface of the waters. In like manner metal ions in molten magma would be carried to its surface, thus explaining the "mineralizations" of the granites that floated upon the denser basalts. Such "mineralization" would be greatest in the regions of molten-cyclones whose rotation was caused by dense currents of spirally ascending electrons.

An electron camera has been recently invented, in which a magnet focuses electrons upon the sensitized film. If our theory of electron emission from large celestial masses is true, it should eventually be possible to photograph many details of the sun and other stars with an electron camera. Even invisible electron-shells of vast diameter and enormously distant planets should thus become known.

Since more electrons than protons are emitted by the sun and other stars, it follows that very high-speed electrons must be coursing through space; for an emitted electron is accelerated not only by those in the star but in its atmosphere and surrounding electrons and electronospheres upon its emergence from them. Very high-speed electrons are, I believe, the "cosmic-rays." Since either these electrons, or the protons that they emit upon impact, cause ionization of molecules, it follows that they probably cause the luminosity of the "giant stars." The latter evidently have electronospheres (loaded with gases) of vast diameter, rendered luminous by the ionizing effects of the high-speed electrons emitted from the molten-core of the star. Such electrons probably produce the "unknown influence" on the special lines of hydrogen, helium, etc., that Russell discusses in his Astronomy. Speaking of the luminosity of comets, he says: "What stirs the gases up to shine is not fully understood." Again the answer is high-speed electrons emitted by the sun. Even terrestrial auroras probably owe their brilliancy to high-speed solar electrons. The same may be true of the "night sky light" and the zodiacal light.

A very important inference from our theory is this: Electrons of cosmic-ray speed, emitted by the greatest stars, ionize the atoms in their electronospheres so highly as to produce the same spectral effects as are produced by high temperature. When they penetrate stellar electronospheres in great numbers they cause the bright-line spectra of H, He, etc., by ionizing the outer atoms. The absence of metal spectra in such stars is further evidence that we are dealing here with very low temperatures and with very high-speed electrons.

A complete revision of astrophysics must follow if this theory of preponderant electron emission is correct. It clears up so many anomalies and explains so many puzzling phenomena that it bids fair to be an open sesame in many a scientific realm.

CONCLUSIONS REGARDING DIVIDED LANE HIGHWAYS

Tentative conclusions based on the experience of the Indiana State Highway Commission in selecting and designing divided lane roads were given as follows by M. R. Keefe, Chief Engineer of the Commission, in a paper presented Sept. 8 at the 24th annual convention of the Canadian Good Roads Association.

1. On class one, or arterial roads, if traffic count exceeds 5,000 and accident rates are high, they should be rebuilt as divided-lane roads.
2. Where traffic trends show high percentage of increase and road requires rebuilding, provide right-of-way for divided-lane road, building at present two-lane road, 22 ft. wide.
3. Pavements on divided-lane roads to be designed with a minimum width of 22 ft. Drainage of center parkway to be carried to center between lanes.
4. Use 30-ft. minimum center parkway width, increasing to 40 ft. at state highway intersections.
5. When right-of-way costs become excessive, as well as through towns and villages, use 4-ft. median dividing strip of some contrasting color to provide better visibility at night.
6. When funds are not available for separations at highway intersections, make provision in right-of-way purchases for future construction of the separation, using traffic-light protection temporarily.
7. Intersection designs shall provide acceleration and deceleration lanes to facilitate turning movements of the traffic.
8. Eliminate planting in center parkway except for low-growth shrubs. Nothing shall be placed in center parkways that produces marginal friction.
9. All railway-highway crossings must be separated.
10. Provide crossovers at all intersecting public roads and streets and intermediate crossovers at a minimum distance of 800 ft. Public road and street crossovers shall have sufficient length to allow a "U" turning movement for vehicle length of 40 ft.
11. Design for speed of 80 m.p.h. and provide a minimum vertical sight distance of 700 ft.

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A.G.C. and A.R.B.A. Announce Concurrent Convention Arrangements

The national convention of the Associated General Contractors of America, to take place in San Francisco, March 5 to March 11, 1939, will be held concurrently with the annual convention and exhibit of the American Road Builders' Association. The convention sessions of the Associated General Contractors of America will be confined to intense business sessions, at which the program of the contractors for the following year will be developed. Persons of national prominence in all lines of construction, both public and private, will appear on the program. The convention sessions will be so arranged as to permit ample opportunity for the contractors to view the many forms of new construction equipment and machinery. The exhibit will include types adapted to both highway and heavy construction.

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ANOTHER MISSISSIPPI RIVER TOLL BRIDGE—The Reconstruction Finance Commission has authorized a loan of $2,100,000 to the city of Greenville, Miss., for the construction of a toll bridge for vehicular traffic across the Mississippi River on the Birmingham-Dallas Highway. The total cost of the bridge will be approximately $4,125,000, the PWA furnishing the balance of the funds on a grant basis.

A $27,900,000 CIRCUMFERENTIAL PARKWAY FOR NEW YORK CITY

A $12,000,000 PWA grant has been made to New York City for the construction of a 39-mile circumferential parkway around Brooklyn and Queens with connections of existing parkways in Long Island, Manhattan and the Bronx. The balance of the $27,900,000 required for this project will be provided by the city.

The parkway will provide a short route to Long Island, Jacob Riis Park and the Rockaways. Some 70 bridges, with access drives at important intersections, will provide a modern artery without the inconvenience and involved danger of grade crossings. The bridges will be wide enough for three lanes of traffic in each direction. The pavements on grade will consist of two separated strips of concrete 23 ft. wide. They have been located so that an additional lane in each direction may be added at a future time. The bridges will be typical parkway type, with stone masonry facings, and in addition to bridges for vehicular and pedestrian crossing, several railroad bridges are planned.

The Parkway will skirt Jamaica Bay, which is planned as a future recreational and residential center. Moreover, the project will provide the remaining links in the Metropolitan Loop, by which motorists will be able to encircle the Metropolitan area without encountering traffic congestion.

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PROFESSIONAL ENGINEERS MEET IN PITTSBURGH—OCT. 17-19

Members of The National Society of Professional Engineers will convene for the society's fourth annual convention in Pittsburgh, October 17, 18 and 19.

This year's convention, to be held in conjunction with that of The Pennsylvania Society of Professional Engineers, will be called to order at 10 a. m., October 17, by Engineer Samuel Eckels, convention chairman and former Chief Engineer of the Pennsylvania Department of Highways.

The tentative convention program, arranged by Engineer Charles A. Finley, program chairman, includes a showing of the United States Steel Company's motion picture, "Steel, Man's Servant," luncheons, dinners, dancing, cards, floor shows and sight-seeing trips. These trips will include visits to the Mellon Institute, the University of Pittsburgh's Cathedral of Learning and Carnegie Institute of Technology as well as visits to Pittsburgh's varied industrial plants.

Business sessions and talks by nationally prominent engineers are also included on the program. Convention headquarters have been established at Hotel William Penn.

Benjamin H. Aires, 610 Maloney Building, Pittsburgh, Pa., is secretary of the National Society.

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Can You Stand This One?

To the Editor:

Many of our citizens have and use a foreign tongue until it crowds their English into interesting forms. Here is a case I think I should no longer hide.

"Levelations" has been used for what we call elevations, as determined with a level. Does it merit room in the dictionary?

Yours truly,
F. O. Nelson,
Engineer and Surveyor,
Toledo, Iowa,
August 16, 1938.

EDITORIAL

MORE BRIDGES FOR LESS MONEY

WAKE UP! Bridge engineers! If you demand more for your money you'll get some concentrated study on the problem of 20,000 obsolete bridges on the state highway systems alone.

About 20 years before the Civil War the Bessemer process of steel manufacture was invented. For the last 50 years you have been using the same kind of steel. Why? I can see no good reason why you have not insisted upon a higher strength steel for less money. You have been satisfied, apparently, to use a stress of 16,000 or 18,000 lb. per square inch because you considered it "good practice." You read in your college text books that 16,000 lb. was the accepted design stress and have allowed yourselves to be branded with the "dash board disease." For the benefit of those who may wonder what the "dash board disease" is, I'll explain. I learned the expression from my college professor of structures, Prof. J. E. Kirkham. He said that when automobiles were first built the dash boards were equipped with whip sockets. That's what's wrong with bridge design today—both steel and concrete. In concrete design you employ 650 lb. per square inch as allowable concrete stress and control the mix to be sure you get 3,500 or 5,000 lb. concrete at 28 days.

Instead of designing economic structures you are wasting public funds. Wait, I'm not through yet!

I submit that the assumptions upon which your designs are based need investigation and revision. I submit, with regard to steel, that you should demand higher strength steel from the steel producers at a lower cost than you now pay for ordinary structural steel. I submit you may be justifiably criticized for not demanding a steel that the producer can guarantee against rust or corrosion for 30 years. Why should so much money be spent, annually, scraping, brushing and painting? We should have a fabricated steel structure today that will require no maintenance. We should also have a rust resisting steel for abutment and pier construction in order to reduce the cost of substructures.

I've heard it stated that an economical crossing is one in which the cost of the substructure equals the cost of the superstructure. Bosh! Bridge engineers have completely forgotten, if they ever knew or thought of it, that a riveted steel truss is, in itself, a simple beam. You are designing bridges from the point of view of individual members and giving no value whatsoever to the strength of the fabricated unit as a whole. I could cite many examples to prove this point; I don't think that is necessary.

Wake up! Look into the assumption upon which design formulae are based. Reduce the factor of ignorance —pardon, factor of safety. If this one factor alone was cut in half, i. e., use nearer 30,000 lb. per square inch or even 34,000, then the public would be getting somewhere nearer the value of their dollar even with the common grade of structural steel as now produced. With modern testing equipment to help make inspection of individual pieces, there need be no reason to think a flawed or over-stressed shape would be used. There has been some progress, albeit not near enough, in the fabricating plant procedure that you have given no consideration whatever.

State highway department bridge engineers know from bitter experience with budgets how their allotments are whittled down and an old bridge left in a new road. This is done so often it seems like a deliberate attempt to create bottlenecks and accident producing points. Of course, we know that is not the intent, but undeniably it is the result.

Give the taxpayer more bridges for his money!

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CAN'T CALL THEIR SOULS THEIR OWN

POLITICAL pressure, particularly in a place where politics and political groups are the major subject of conversation, life, and recreation of a populace, establishes conditions and causes arrangements to be made that ordinarily, under the free application of economics, would never exist. The boldest political interference I have noted is that which held sway and which holds forth in one of our western states at the present time.

As an engineer or employee of a state highway department how would you feel if you were required to make a "voluntary contribution" of 2 per cent of your pay check to the state chairman of the political party in power? As an engineer in charge of construction work how would you like to have a political party county chairman dictate who should be employed on your job, in what capacity, and at what rate of pay? Supposing one of the men ordered onto your job by the county chairman carelessly damaged an expensive piece of equipment and you fired him, how efficiently do you think you could organize and operate your construction job if the county chairman ordered you to put the man back to work and to see that he lost no pay for time not worked after you fired him? How efficiently do you think you could administer your highway department when even the governor of the state belittles himself to the extent of directly instructing one of your subordinates to reemploy a man whom that subordinate had discharged for destroying an expensive unit of equipment? If you were a state highway engineer, how economically do you think you could build a road when, through political pressure from technically ignorant men, you are required to replace a designed drainage structure with one over twice as large and three times as expensive?

In the western state of which I speak a "request" from the incumbent political party county chairman is tantamount to an order. These individuals, hopelessly ignorant in technical engineering knowledge, dictate to the engineers, who shall be employed, and often on what equipment or in what capacity. I saw a written note from a county political party chairman to an engineer "requesting" the latter to reinstate a man whom the engineer discharged for carelessly damaging expensive construction equipment. The written note "requested" that steps be taken to see that the discharged man suffer no loss of pay for the time he was not working because of the discharge.

Citation of names and places is not of importance. That such a system as this should be allowed to exist is our criticism. We extend our sympathy to the state highway engineer and to his staff, for the unrestrained interfering and nearly unbearable conditions under which they must work. We hope that, in due course of time, men will be elected to executive offices in this western state who will realize the importance of liberating the highway department from the oppressive hand of political pressure.

NEW EQUIPMENT AND MATERIALS

New Speed Maintainer

The speed maintainer, a new finishing and maintenance tool designed for the use of contractors, state, county and township highway divisions, park boards, city street departments and airports, has been announced by the Allis-Chalmers Manufacturing Co., Milwaukee, Wis. The speed maintainer is one-man operated and will, it is stated, maintain the average earth or gravel roads at from 3½ to 4¾ miles per hour. It is particularly well adapted to highway shoulder maintenance. Ability to turn short, in a 16-ft. circle, makes it ideal for fine grading between forms or for use in narrow alleyways. Originally planned for contractor use, the

Allis-Chalmers Speed Maintainers

speed maintainer has proved a fast, low-cost means of breaking up big clods and leveling behind blade and elevating graders. It is mounted on pneumatic tires and has a top speed of 9 miles an hour. The specifications: Length of blade, 9 ft.; height of blade, 13½ in.; blade clearance, 9½ in.; blade pressure, 3,990 lb.; angular rotation, 70 deg.; weight, 4,140 lb.

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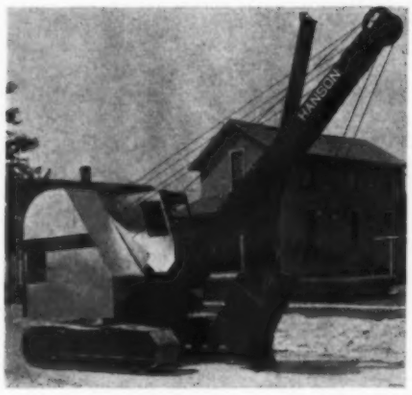
New Hanson ⅜-Yard Unit

The Hanson Excavator Works, the crane and shovel division of the Hanson Clutch and Machinery Co. of Tiffin, Ohio, have in production a new ⅜-yd. rig named the "Comet," which they make in any combination of a shovel, crane, clamshell, dragline, pile driver and/or trench-hoe. It is a full revolving machine, mounted on an electric welded steel lower base or frame of rigid design.

The crawler frames are heavily webbed and equipped with countersunk Zerk fittings. The crawlers are oversize in comparison to the weight of the machine thereby giving ease of travel and operation.

The upper turret frame carries the machinery on a ring gear revolving on rollers of the Hanson multiple hook type requiring no center pin adjustment at any time.

All shafts on upper deck are mounted on roller bearings that do not require grease or oil at any time and/or Timken taper roller bearings requiring lubrication once weekly. Each shaft is so mounted that the removal of one may be made without disturbing any other.



The Hanson "Comet"

All clutches, which are lockheed Hanson patent of the expansion double shoe type are independent hydraulic controlled (automatic fluid control for each clutch and brake) and are said to give the operator great ease in running. The shoes in the clutches and brakes may be relined without dismantling the shafts.

The "Comet," the baby of the Hanson shovel family, weighing approximately 20,000 lbs., has the same independent control features as the heavier Hanson machines from ¾ yard to ¾ yard in capacity. It is possible to crowd, hoist, swing, propel and raise the boom simultaneously. Either chain or cable crowd and either Ford V-8 or Hercules six-cylinder engine is available.

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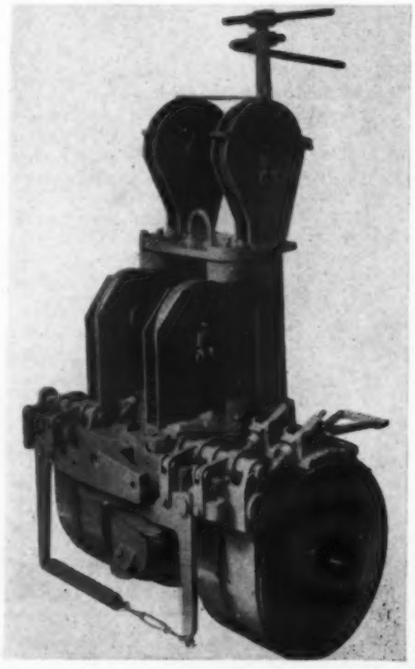
New Heavy Duty Power Control Units

Emsco Model G-L-T heavy duty power control units in single and double drum types of standard, long drum, and four drum models, recently have been announced by the Emsco Derrick & Equipment Co. of Los Angeles, Calif., and Findlay, O.



Emsco Model G-L-T Heavy Duty Power Control Units

According to the manufacturer, these units are the result of a comprehensive study of field conditions and contractor experience. The clutch and brake linings supplied on these units are unconditionally guaranteed by the manufacturer for 90 days. The main drive gears are of the heavy duty truck type spiral bevel gear construction, all gears being of a nickel-chromium steel, hardened and ground, mounted on heavy duty Hyatt and Timken roller bearings. All gears and bearings are totally enclosed in a steel case and run in a bath of oil of the same quality and viscosity as used in the transmission of the tractor. Only three oil seals are required, one for each drum and one for the drive pinion shaft. The seals are all above the oil level, are required to seal only oil vapor, and therefore reduce oil leakage to the minimum. The main hoist shaft is of SAE 4140 (Molybdenum) steel, heat treated, 2½ in. in diameter. The design of the shaft is such that it is subjected only to torsional driving force, the cable drums being mounted so as to rotate on forged steel extensions of the drive gear housing itself, which gives a full floating drive to the drums in such a manner that the cable pull is transmitted directly to the hoist housing and not to the drive shaft. The cable drums are 11¼ in. in diameter on the bare drum barrel, this extra large diameter reducing cable wear to an absolute minimum, since it enables the cable to spool properly and prevent uncoiling when the line becomes slack from over-free spooling. It also prevents cable cross-over and consequent kinking and crushing of the wire rope on the drums. The fair lead assists the large diameter drums in correct spooling of the cable. The swivel sheaves, 9½ in. in diameter, have an extra wide angle of sleu for side turning and are mounted on Hyatt roller bearings. A single control lever for each drum is located convenient to the operator's reach. The hoist is easy to operate and reduces operator fatigue to the minimum. The cable drums can be operated either when the tractor is moving or standing still. Only two simple adjustments are required for each drum, one for the clutch and the other for the brake. All adjustments can be made from the tractor platform. Mounting of these units on any tractor is extremely simple and easy, as no cutting or drilling is required. The mounting uses fastening points provided by the tractor manufacturer and an automatically aligning internal-external gear type coupling connects the power takeoff shaft to the winch. The line speed at approximately 900 R.P.M. standard gearing is 300 R.P.M. on the standard model, while the maximum line pull is 10,000 lb. The cable capacity of the various models ranges from 190 ft. to 350 ft. of ½-in. line.

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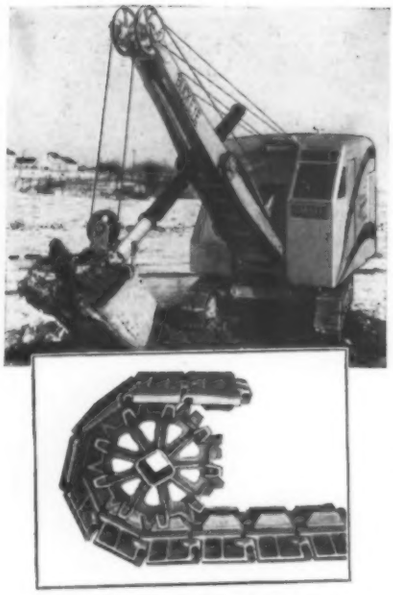
New Crawler Tread

An important development in crawler traction design is being used on Buckeye Clipper convertible excavators, built by The Buckeye Traction Ditcher Co., Findlay, O. The new crawler tread is a patented improvement with several distinct advantages over other types of tread now in use. One advantage claimed is the



New Buckeye Crawler Tread

absolute freedom from clogging. There are no pockets in the tread where loose materials can lodge. The single lug in the center and the wide roller track on each side of the lug are stated to give a positively non-clogging surface. Since the bearing surface on the top of the lug is cast to a radius similar to that of the sprocket rim, there is little wear on the sprocket rim where the load is carried. This bearing surface it is stated will not wear out of pitch and keeps the treads in a true pitch circle. This feature of the new tread is a patented improvement found only in this crawler. Another advantage claimed for this design is the way the treads fold around the tooth on the sprocket, with no rubbing of sprocket teeth in or out of engagement. This keeps wear on the teeth confined to drive pressure. Relatively high speed operation is practical without excessive noise. The new crawler tread is now standard equipment on all Buckeye Clipper excavators, and is built exclusively by the Buckeye Traction Ditcher Co.

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New Traffic Line Machine

A new equipment for painting traffic lines said to affect important economies by reason of its speed of operation and saving in paint and labor, has been brought out by Saylor-Beall Mfg. Co., Detroit, Mich. It is stated the machine enables an inexperienced operator to lay down from two to four miles of accurate, clean-cut line, from 2 to 6 ins. wide, in an hour. In addition to traffic lines the equipment is designed to define playing fields, parking lots, air ports, tennis courts, etc. Dual spray attachment is available for painting parallel lines. When equipped with extra gun, cup and hose, the outfit is useful for painting traffic guards, fire hydrants, street name signs, alarm boxes, etc. The equipment consists of a single cylinder air compressor, driven by a gas engine, 12-gal. paint storage tank, pressure feed spray unit, all mounted on rubber tired, ball bearing wheels. Edges of spray are cut off by articulated shields, free to move vertically, making operation feasable over rough surfaces. Flow of material is regulated by operator through positive control trigger on guiding handle. The pressure feed feature is said to insure a deeply penetrating, long-wearing line, and the efficient atomization results in a remarkable saving in material. Thorough cleaning without dismantling is provided for with an auxiliary cleaning tank. The outfit weighs 150 lbs.

Sayler-Beall Line Marking Machine

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Hopper for Storing Wet Concrete

A new steel receiving and dispensing hopper for receiving a full load of truck mixed concrete and dispensing it into wheelbarrows and carts as needed is now being built by the Ransome Concrete Machinery Co., Dunellen, N. J. This allows the truck mixer to immediately be dismissed and become available for other jobs. The hopper has a bottom discharge equipped with two lever operated double-clamshell discharge gates which control the flow of concrete into barrows or carts. The use of this hopper is stated to eliminate all possibilities of segregation of aggregates and to assure a uniform load of concrete for the job. In operation, the hopper is towed to the job behind any convenient truck and rides on a special pneumatic-tired trailer under-carriage, which upon arrival at the job is quickly detached from the hopper by the use of an eccentric lever and the removal of 4 bolts. The total height of the hopper and frame is 10 ft. and the width is less than 8 ft. when in carrying position. At the job, the steel-angle extension legs of the hopper are dropped from the carrying position in which they were held while on the road, and the channel skids connecting the legs are turned up to a level position. By means of sheaves and cable the arriving mixer truck first lowers the hopper body by rotating it inside its frame to a receiving position, with one side of the hopper resting on the ground. Dumping the entire truckload of concrete rapidly over the 3-ft. 7-in. high loading side of the hopper which holds the full load of concrete, the mixer truck when empty swings the hopper up to its discharging position by means of the same sheaves and cable where it automatically locks in upright position. In this position the concrete can be withdrawn as needed by running carts or wheelbarrows under the two separate discharge openings controlled by the clamshell gates. Two lines of barrows or carts may be operated simultaneously from the hopper.

Hopper for Storing and Dispensing Truck Mixed Concrete

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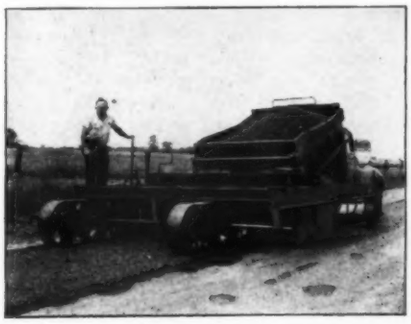
New 1½-In. Dual Prime Pump

Originally introduced as a 1¼ in. pump, this unit made by Construction Machinery Co., Waterloo, Ia., has recently been enlarged to a 1½ in. size with consequent greater capacity and better performance. Although small and light weight, the CMC "Little Wonder" is slated to have all the big pump features such as the exclusive dual prime method of priming with recirculation cutoff, built-in neoprene suction check valve, not affected by oil or gasoline, trash type impeller, double grease seal, and large water capacity in pump case. Powered by ¾ to 1 hp. 4-cycle air-cooled engine with Zenith float feed carburetor, upper gasoline tank, sediment bult and fuel strainer, ball bearing crankshaft, and high tension magneto. This pump is stated to be able to deliver up to 5,000 gal. per hour, depending on conditions, and will prime itself automatically on suction lifts up to 25 ft. The same unit can also be furnished with ½ hp., 1750 r.p.m. electric motor, or suitable for flexible coupling or belt drive. The overall dimensions of the pump are—Length, 19 in.; width, 10 in.; height, 14 in. Net weight of pump made from aluminum alloys, 60 lbs.; Approximate weight when made from iron alloys, 85 lbs.

CMC 1½ in. Dual Prime Pump

New Spreader and Finishing Machine

A new spreader and finisher for new construction as well as resurfacing work has been brought out by The Shunk Mfg. Co., Bucyrus, Ohio. The machine spreads and automatically grades in one operation. It will handle hot or cold mix, plant mixed surface courses and base courses of all types. The rear end of the machine is supported by wide-faced, endless and flexible belted tracks or trends giving 6-point surface contact. This rear drive runs on the newly laid surface, and the feature is claimed to eliminate the possibility of reproducing any old depressions, ruts or holes. The oscillating movement of the screed is furnished by a connecting rod powered off the six rear wheels. This oscillating action



D-K Spreader and Finishing Machine

is stated to accelerate the flow and to prevent bridging of wet or chemically treated aggregates. Its location back of the hopper and strike-off bar allow all the material to settle first before spreading and leveling. The screed speed can be varied to suit the various classes of material and can be tilted to suit the desired crown. It is claimed that with this machine material may be laid from a thin mat to any desired thickness, or may be laid 1 to 3 in. thick on one side and 3 to 6 in. thick on the other side. The hopper is made of heavy sheet steel and has a capacity of 3 tons. The materials are discharged from the trucks into the hopper. The trucks haul the unit forward until the hopper empties. The machine has a wheel base of 18 ft., 7½ in., an overall length of 20 ft., 5½ in., an overall width of 11 ft., and an overall height of 4 ft.

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New Portable Electric Grinder

Three new grinders, manufactured in 4 in., 5 in., and 6 in. diameter wheel capacities, have been announced by the Independent Pneumatic Tool Co., 600 West Jackson Blvd., Chicago, Ill. These grinders, states the company, are practical to use even on production work where constant, severe service is required because of a newly perfected method of vibration control. A simple change in the basic design of the spindle . . . substituting resilient steel strips for a single solid piece . . . provides this control of vibration from the wheel. The spindle in Thor portable electric grinders is a 2-piece shaft, joined with resilient steel strips. It absorbs and stops all vibration before it reaches the motor. The steel strips—not the motor—take the shocks and prevent lead wires to the commutator from crystallizing and breaking. The streamlined design, light weight and compact construction of Thor grinders provide easy handling wherever the job may be. The 4-in. grinder, known as the Thor U54, is recommended for fast grinding on light jobs. It weighs 10 lb., is 19 in. long and operates at a free speed of 6,000 r.p.m. The 5-in. grinder, called the Thor U55, operates at a slower speed for heavier duty work. It weights 10¼ lbs., is 19½ in. long and runs at a free speed of 4,500 r.p.m. The 6 in. grinder, Thor U60, is designed for the very hardest kind of grinding jobs. It weighs 20 lbs., is 24½ in. long and has a free speed of 6,000 r.p.m.

New Type Concrete Buster Steel

The Sullivan Machinery Co., Michigan City, Ind., has recently developed and marketed a new type of steel known as "Arropoint," designed for use with pneumatic concrete busters. The outstanding feature of the new steel is an upset end which provides a wider, more efficient point angle and locates more stock at the working end of the steel to provide greater resistance to drilling and breakage. It is claimed that Arropoint steels last longer, stay sharp longer, break concrete faster and are easier on the operator than conventional steels. They are available in all standard buster steel sizes and with both pick (moil) points and narrow chisels.

New Oil for Removing "Frozen" Bolts

As a result of an interesting laboratory discovery of a new method which reduces surface tension of liquids, a new product has been developed known as Kano Penetrating Oil. Laboratory tests are stated to have shown that this oil will pass through openings as small as an estimated millionth of an inch. Practical tests were made in many types of industrial uses—for instance, in the removal of lids from coke ovens. These lids are bolted down and are subjected to high temperatures over considerable periods of time. Heretofore, it has been impossible to remove the bolts except by cutting them with acetylene torches—all penetrating oils having failed to loosen the threads until a test of Kano Penetrating Oil was made. Now, the operator sprays the 115 bolts around the lid and by the time he makes his circuit, he can turn off the first nut sprayed. Many tests have been made by motor mechanics where it was found that the most stubborn cases of frozen threads were loosened in less than a minute—for instance, clamps around mufflers and exhaust pipes, fender and body bolts, spring and shackle bolts, etc. In many cases, nuts which refused to budge were loosened in one minute's time. Kano Penetrating Oil is being marketed by the Norwood Products Co., 75 East Wacker Dr., Chicago, Ill.

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WITH THE MANUFACTURERS

Carl L. Pfeifer Dies

Carl L. Pfeifer, Treasurer of the Chain Belt Co., Milwaukee, Wis., died suddenly, in Philadelphia, Penna. He had left Milwaukee the day before for Philadelphia on business and was stricken upon his arrival there. Mr. Pfeifer was born in Chicago, Ill., in 1880, where he received his education. In 1914, he was employed by the Chain Belt Co. as comptroller after leaving the employ of Arthur Young & Co. In 1916, Mr. Pfeifer was elected treasurer of the Chain Belt Co., a position which he held until his death. Mr. Pfeifer was at one time director of the National Association of Cost Accountants and the Controllers Institute of America in which organizations he was very active. For a number of years he was connected with the Milwaukee Goodwill Industries and was active in other charitable work throughout Milwaukee. He is survived by his wife, a daughter, and two sons, G. Herbert, with the Chain Belt Co., and C. Lowell, an instructor at Marquette University.

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Emsco Announcements

L. J. Gardella has recently been appointed sales manager for the western territory of the Tractor Equipment Division of Emsco Derrick & Equipment Co. Mr. Gardella before becoming associated with Emsco was manager of the tractor division of Smith Booth Usher Co., previously being connected with the Austin Western Road Machinery Co. in sales and sales promotional work, and with the Universal Power Shovel Corporation as manager of sales. Other announcements by the company were the transfer of N. G. Livingstone to San Francisco as northwestern representative, D. C. Royce as southwestern representative located in Los Angeles, and Pat Stuart, located in Denver, as district representative in the Rocky Mountain states. Emsco have also announced their appointment as exclusive manufacturer and distributor of the complete line of power shovels and equipment manufactured by the Universal Power Shovel Corporation of Milwaukee, Wis., for the eleven western states and Texas.

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W. A. Olen Re-elected President FWD

The annual stockholders' meeting of The Four Wheel Drive Auto Co. was held at Clintonville, Wis., Sept. 13, with 109,115 shares represented in person or proxy. W. A. Olen, president and general manager, gave a detailed account of the company's activities for the past fiscal year which closed on June 30th. Gross sales for the company, he said, totaled $4,143,834.59 which was a slight increase over the total volume of business for the previous fiscal year. The year's operations resulted in a net loss of $113,190.78 which Mr. Olen stated was due to increased labor costs and short working hours together with other unusual expense, shrinkage in inventory and other factors of an unusual non-recuring nature. At the election of directors W. A. Olen, Frank Gause, and D. J. Rohrer were unanimously elected to succeed themselves for a three year term. At the organization meeting of the Board of Directors held after the stock-holders' meeting W. A. Olen was re-appointed president and general manager with Antone Kuckuck of Shawano, J. D. Cotton of Chicago and H. M. Daniels of New York as vice presidents. D. J. Rohrer and Frank Gause were re-elected as treasurer and secretary respectively.

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Continental Announces Price Reductions on All Models

The Continental Roll & Steel Foundry Co., Tractor Equipment Division, East Chicago, Ind., has announced a reduction in prices effective Sept. 20, 1938, on their entire line of wagon scrapers including 4, 5, 7, and 10 yd. models mounted either on low pressure tires or crawlers. Design and construction are unchanged, and price reductions cover all models except those produced by outside sources such as hydraulic hose connections, tires and crawler tracks. All units will be identically the same as those furnished prior to the price cut. The new prices, the manufacturer states, are the lowest at which Continental wagon scrapers have ever been sold. It is expected that the new lower prices will provide an increased sales volume which will justify the price reduction. The revised price structure extends to export, as well as domestic, sales according to G. B. Wadlow, manager, Tractor Equipment Division.

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Jahn Sales Office Moved

The sales office of C. R. Jahn Co., are now located in its factory building, 1345 West 37th Place, Chicago, Ill. The change was made early in September.

Frank W. Heiskell Retires From the International Harvester Company

Frank W. Heiskell has retired. For more than 25 years he was advertising manager of the International Harvester Company. Prior to Oct. 1, 1911, when he came to Chicago as assistant advertising manager, Mr. Heiskell had been proving himself in several branch house territories as a go-getting salesman. He had a particular bent for cashing in on the advertising available at the time to facilitate his selling and also the selling of various dealers working under his direction. Mr. Haskell's entire business career was devoted to the International Harvester Co. and one of its predecessors, the McCormick Harvesting Machine Co. He entered the employ of the latter company in the repairs department of the Indianapolis branch in June, 1893.

F. W. Heiskell

Throughout the many years in charge of International Harvester advertising, Mr. Heiskell has been a strong advocate of steady advertising, in lean years as well as fat. In periods of depression when the tendency was to cut down costs in every direction, Mr. Heiskell always insisted that there be no let-up in the advertising campaign. When times were hard, he declared, it was much cheaper to keep prospective customers posted about the company's products by advertising than by personal calls. In fact, if there was to be a time for lessening the intensity of the advertising campaign, he said, it should be when times were good and sales were comparatively easy to make. Mr. Heiskell deserves distinction among advertising executives for steadily and unrelentingly adhering to this fundamentally important advertising policy.

Mr. Heiskell's retirement became effective October 1. He is succeeded by A. C. Seyfarth, who has been assistant advertising manager.

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Bert L. Wood Now Engineer of American Iron and Steel Institute

The American Iron and Steel Institute has announced the appointment of Bert L. Wood, formerly of the Carnegie-Illinois Steel Corporation, as engineer in charge of a new program for the promotion of the broader use of light steel construction in buildings. Mr. Wood's activities will be directed toward getting an equality of recognition for light steel products with other kinds of building materials. The use of heavy structural steel has long been established in the construction field, but the use of light steels in residential and other building is a development of recent years and many building codes give them little or no recognition. At present the revision of building ordinances is in progress or is in contemplation in some 228 cities. Mr. Wood is a graduate engineer of Cornell University and has had long experience in the steel and building industries. He was associated with Kalman Steel Co. and Bethlehem Steel Co. before joining the Carnegie-Illinois Steel Corporation.

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A. C. Seyfarth New IHC Advertising Manager

Retirement of Frank W. Heiskell as advertising manager of the International Harvester Company, after 45 years of service with that company and the McCormick Harvesting Machine Company, is announced elsewhere in this issue. Mr. Heiskell is succeeded as advertising manager by A. C. Seyfarth, formerly assistant advertising manager. Mr. Seyfarth, widely known in the advertising profession, entered the employ of the Harvester Company in 1904 after attending the University of Michigan and the University of Chicago, and after working for a short time as an advertising solicitor. His first job with the company was as a catalog writer. Successive promotions advanced him to chief catalog writer and copy chief, where he was in charge of all advertising copy production. He became assistant advertising manager in 1913. Mr. Heiskell's entire business career was given to the service of the McCormick Harvesting Machine Company and the International Harvester Company. On August 1, this year, he rounded out his 25th year as advertising manager of the Harvester Company.

A. C. Seyfarth

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New Distributors for The Hercules Co.

The Hercules Co., Marion, O., has announced the recent appointment of the following distributors to handle the sale of Hercules Road Rollers and Ironerolls, in their respective trade areas: J. B. Hunt, Raleigh, N. C.; Rathman Equipment Company, Rapid City, S. D.; Rome Tractor Sales Company, Rome, N. Y.; Webster & Hedgcock Tractor & Equipt. Co., St. Louis, Mo.; S. G. Hawkins, Houston, Texas; Mussens, Ltd., Toronto, Canada. Full particulars on the Hercules line of Road Rollers including catalogs, specifications and prices are now available from each of these firms.

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NEW LITERATURE

Snow Plows—An 8-page circular on its interchangeable blade snow plows has been issued by The Austin-Western Road Machinery Co., Aurora, Ill. These types of plows for 1½ ton and 3 ton trucks are illustrated and described.

Bin-Type Retaining Walls—A new 16-page bulletin on the "Armco" bin-type retaining walls has been published by the

Armco Culvert Mfrs. Assn., Middletown, O. The important new feature of this wall is the heavy U-shaped column construction, designed to increase strength and stability. Overlapping units—stringers and spacers—are securely bolted to these rigid columns to form a series of connected bins that are completely closed on all four sides. The new wall is of single-bin construction and is adapted to low or high walls, to curves and to changes in elevation of the top or base. A table of sizes, details and suggested plans are given in the bulletin. A number of uses are illustrated, including slope stabilization, wing walls, restricted right of way, service along lakes and streams where the primary purpose is to prevent erosion or resist wave action.

Crusher Plants—The Iowa Manufacturing Co., Cedar Rapids, Iowa, has just issued its new Roadside Crusher Bulletin RC-2. This new bulletin illustrates and describes the latest type and models of Cedar Rapids tractor-crusher units. A much broader line of combination units is now being offered. The tractor-trailer unit makes possible the utilization of road materials found alongside roadways and salvages this material into surfacing metal at a very low production cost.

Highway Lighting—An 8-page illustrated booklet (Leaflet 60-070) has been announced by the Lighting Division, Westinghouse Electric & Manufacturing Co., Cleveland, O., which gives facts concerning automobile accidents, general information on highway lighting and describes sodium highway luminaires and sodium vapor lamps.

Tractor — Capacities, specifications and mechanical features of the largest "Caterpillar" Diesel Tractor have been grouped together in a new booklet, Form 4876, just issued by the Caterpillar Tractor Co., Peoria, Ill. Printed in two colors, the book is profusely illustrated, the pictures showing action view of the Diesel D8 tractor on the job, as well as cutaway views of the engine, fuel system, transmission, final drive, etc.

Piling—A new 20-page catalog on fluted monotube piles has just been released for distribution by The Union Metal Manufacturing Co., Canton, O. In addition to describing the product and method of installation, this catalog contains complete engineering data as well as illustrations of unusual and interesting Union Metal piling jobs.

Shovels, Snow Plows, Etc. — Six new catalogs have been issued recently by the American Hoist & Derrick Co., St. Paul, Minn. These are: 700-G-11—"American Gopher" 1½ to 2 yd. Shovel-Crane-Dragline; 100-H-1—"American" General Purpose Hoist; 100-H-5—"American," Oil Field Engines; 600-L-2—"American" 40 and 50-ton Locomotive Cranes; SNP-3—"American" Heavy Duty Snow Plows and Wings; SNP-4—"American" Mouldboard Type Snow Plows.

Slide Rule for Computation of Earth Moving Data.—LeTourneau's new improved grade and haul calculator for 12-yd. carryalls—a scientific, accurately engineered and carefully prepared slide-rule for easy computation of all vital earth-moving data—is now ready for free distribution through all "Caterpillar" agencies or by writing R. G. LeTourneau, Inc., at either the Peoria, Ill., or Stockton, Calif., offices. Millions of yards of dirt and thousands of time studies form the background for its countless possible computations, such as: Determine production and costs over any distance of haul up to one mile, over any grade or combination of grades, at any established unit cost per hour based on any load range from 7 to 32 pay yards, with several combinations of scrapers and "Caterpillar" D8 tractors. Determine the expected delivery per hour over any one haul with 12-yd. carryalls, single or tandem. Determine the probable cycle in minutes per trip, single or tandem, over any haul distance up to a mile. Determine the expected trips per hour over any haul, up to a mile, with single or tandem 12-yd. carryalls. Show the maximum haul distance possible with single or tandem 12-yd. scrapers, based on some combined predetermined cost per cubic yard of material and per hour cost for the unit. Find the time in minutes to travel any distance up to a mile in a given tractor gear and speed.

For Your Weighty Problems—A new folder describing the advantages of lifting and carrying heavy loads with tractor power. This 6-page illustrated booklet tells how many contractors have used a tractor and a LeTourneau crane efficiently and economically. This crane has all the mobility of a tractor and lifts with all the power of its engine, transmitted through a standard LeTourneau power control unit. A copy of the folder will be mailed upon request to R. G. LeTourneau Inc., Peoria, Ill., Stockton, Calif., or any "Caterpillar" dealer.

Air Compressors—The Sullivan Machinery Co. of Michigan City, Ind., has released an attractive new 20-page catalog describing and illustrating their Unitair stationary and semi-portable air compressors. A number of refinements and improvements have been made to this popular line of compact, two-stage, air-cooled compressors including the addition of a larger size (435 cu. ft. per minute displacement), the use of force feed lubrication and the design of a simplified automatic stop and start control for motor driven styles. The new bulletin fully describes these improvements and also covers power unit driven types. The current Unitair compressor is available for displacement ranging from 107 to 435 cu. ft. per minute and for commercial pressures up to 125 lb. per square inch.

Asphalt Publications—Five new publications in the Institute Construction Series consist of compilations of papers presented at the Eleventh National Asphalt Conference. They are as follows:

Construction Series No. 40—Soil Stabilization with Asphalt. 48 pages.

Construction Series No. 41—Plant-Mix. 28 pages.

Construction Series No. 42—The Oregon Method of Building Bituminous Macadam; The Place of the Medium Curing Products in Plant and Road-Mix Construction; Selecting Asphaltic Products for Various Types of Surface Treatment. 24 pages.

Construction Series No. 43—Water Control and Erosion Prevention Using Asphalt. 24 pages.

Construction Series No. 44—Types of Asphalt Sidewalks for Country Highways. 12 pages.

Single copies of each of these publications may be obtained without charge, upon request to The Asphalt, 801 Second Ave., New York, N. Y.

Air Compressors—A 60-page catalog has been issued by the Davey Compressor Co., Kent, O. Printed in two colors throughout and bound in colored plastic, the catalog contains more than 100 photographic illustrations, many of them action pictures showing Davey air compressor units in operation throughout the world. In addition, line drawings and artists sketches appear at intervals throughout the book. New equipment announced in the catalog for the first time includes parallel mounted trailer models 105 and 315, which are now offered at standard trailer prices. These were previously produced as custom built units on special order at premium prices. Also announced for the first time is the Davey pneumatic saw and the Davey log splitter.

Truck Mixers — Blaw-Knox Co., Pittsburgh, Pa., has prepared a bulletin, number 1643, describing the operation of its water measuring system on Trukmixers. There is a graphic explanation of the method of water flow and control, and the results of tests conducted by an engineer of the Indiana State Highway Department, under different gauge settings and with tank in level or variously tilted position are summarized.

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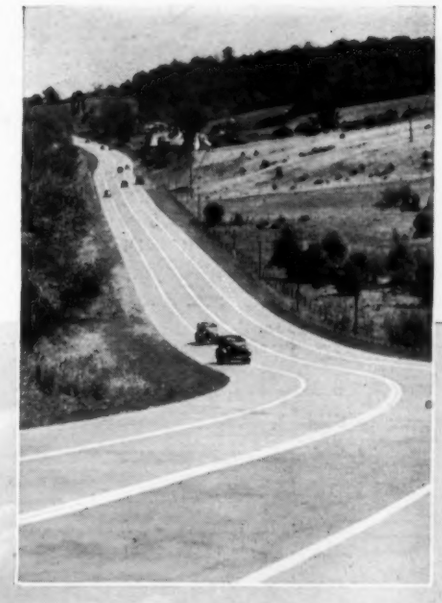

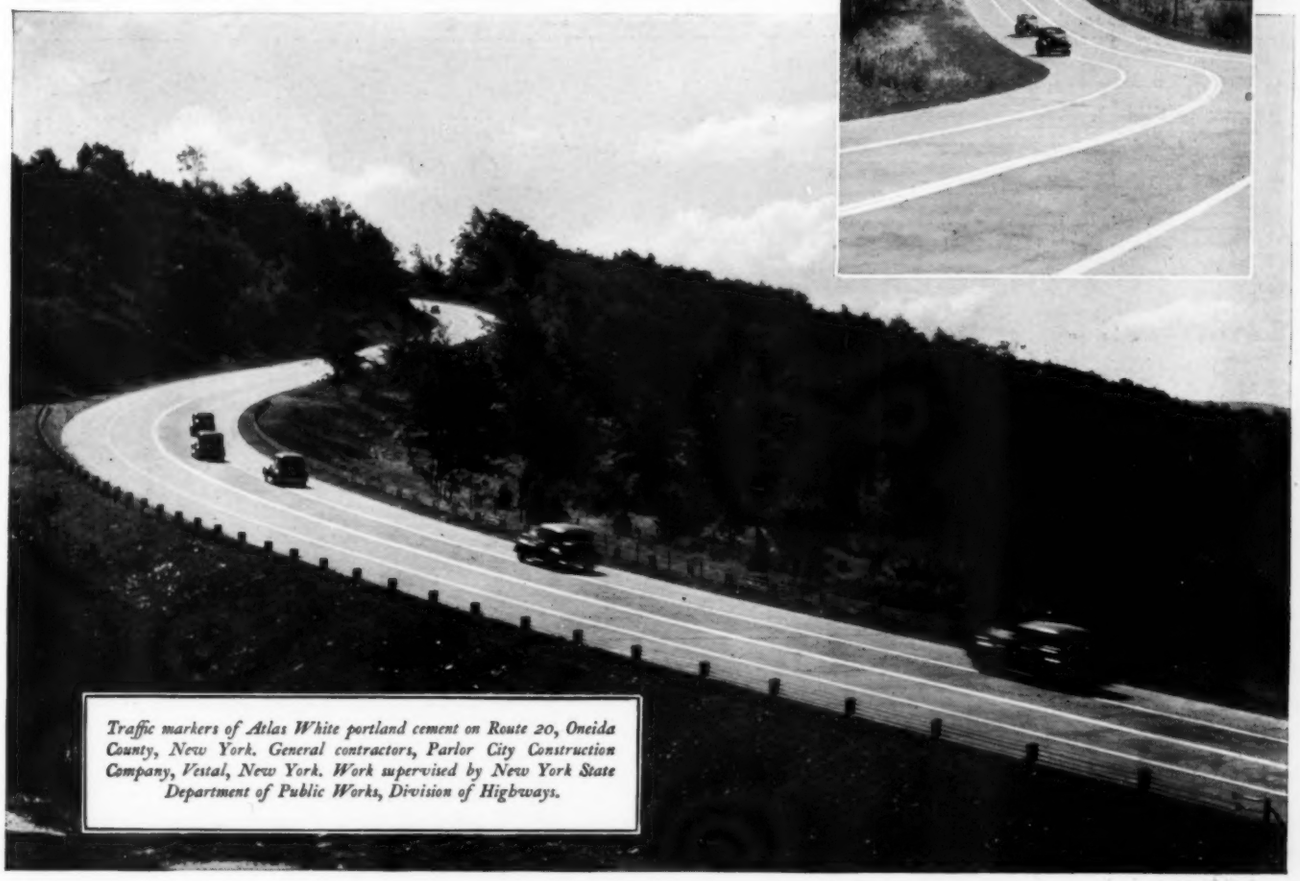

Traffic markers of Atlas White portland cement on Route 20, Oneida County, New York. General contractors, Parlor City Construction Company, Vestal, New York. Work supervised by New York State Department of Public Works, Division of Highways.

CHECK the virtues of these traffic markers of Atlas White portland cement:

Easy to see? Yes. Easy to install? Yes. Economical? Double yes! Economical because they are *permanent*. You install them, and forget them. They'll never have to be painted, repainted, repaired or replaced. Their first cost is the last cost. Think of the savings! It means that over the years markers made with Atlas White portland cement actually pay for themselves.

Atlas White markers (and curbing) are quickly placed. Neither specially trained labor nor costly equipment is needed. They can be made right on the job—or pre-cast in sections indoors and moved to the job. Universal Atlas Cement Co. (United States Steel Corporation Subsidiary), 208 South LaSalle Street, Chicago.

M-23

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C. T. MURRAY
Managing Editor
J. C. BLACK
Field Editor
D. G. LEDGERWOOD
Advertising Editor

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REPRESENTATIVES

Chicago Office
C. A. BLAUVELT
E. C. KELLY
330 S. Wells St., Chicago, Ill.
Telephone: Harrison 1843

New York Office
J. M. ANGELL, JR.
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Vol. 81 NOVEMBER, 1938 No. 11

CONTENTS